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MUNICIPAL ENGINEERING WORKS OF KYOTO, JAPAN.

By S. TANABE*, Dr. Eng.

Kyoto has a population of 400,000 and it is one of the three principal cities in Japan; it is famous for its fine arts, for its old temples, and for the beautiful scenery of the mountains.

The surface of Lake Biwa, the largest lake in Japan, is 280 ft. above the sea, and its area covers 400 square miles. A canal seven miles long connects the lake with the city, and serves both for navigation and water power. The canal was constructed by the author in 1890. (See Eng. News, April 13, 1893.) A view of a portion of this canal is shown herewith.

LAKE BIWA CANAL, NEAR KYOTO, JAPAN.

NEW AQUEDUCT AND NEW HYDRO-ELECTRIC POWER PLANT.

The rapid development in the use of water power in the city of Kyoto has created a larger demand than the capacity of the existing plant is able to supply. The construction of a new canal and the installation of an electric power plant, having larger capacity than the present one, were commenced this year and will be completed in 1910. Mr. K. Sakaida, a graduate of the Kyoto Imperial University, is the chief engineer.

As the water of this new canal is to be used as the source of water supply of the city, it is decided to construct an independent waterway instead of either deepening or widening the existing one. The new canal or aqueduct is, therefore, either a tunnel or a covered way. Its route (see map, herewith) is almost parallel to the existing canal and the tunnels will be constructed from numerous side drifts from the present canal tunnels. The new aqueduct tunnel is 13 ft. wide and 13½ ft. high, with 10 ft. depth of water. It conveys 550 cu. ft. of water per second.

At the city end of the canal there is a fall which utilizes 103 ft. of effective head. The new hydro-electric power plant has to combine the water of the old and new canals. Five 1,700-HP. water-wheels, including one reserve wheel, are to be set, each water-wheel having a direct-coupled dynamo on its axle.

THE KYOTO WATER SUPPLY.

The water of the new canal, before it joins with the existing canal, is divided and is conveyed into a filtration plant situated near the junction.

The filtration plant to be adopted is the American rapid filtration system. The plant will be the first example of this system in Japan. The city of Kyoto is situated on a sloping plane. The north and east is elevated while the southern and western parts are low. The difference of levels being too great the system of water supply is divided into two systems of high and low districts.

Mr. H. Inouye, a graduate of the Kyoto Imperial University, is the chief engineer. The work is to be completed in 1910.

THE CITY TRAMWAY.

The municipality has also to construct a system of electric tramways, which will necessitate

*Professor of Civil Engineering, Kyoto Imperial University; Superintendent Kyoto Municipal Engineering Works.

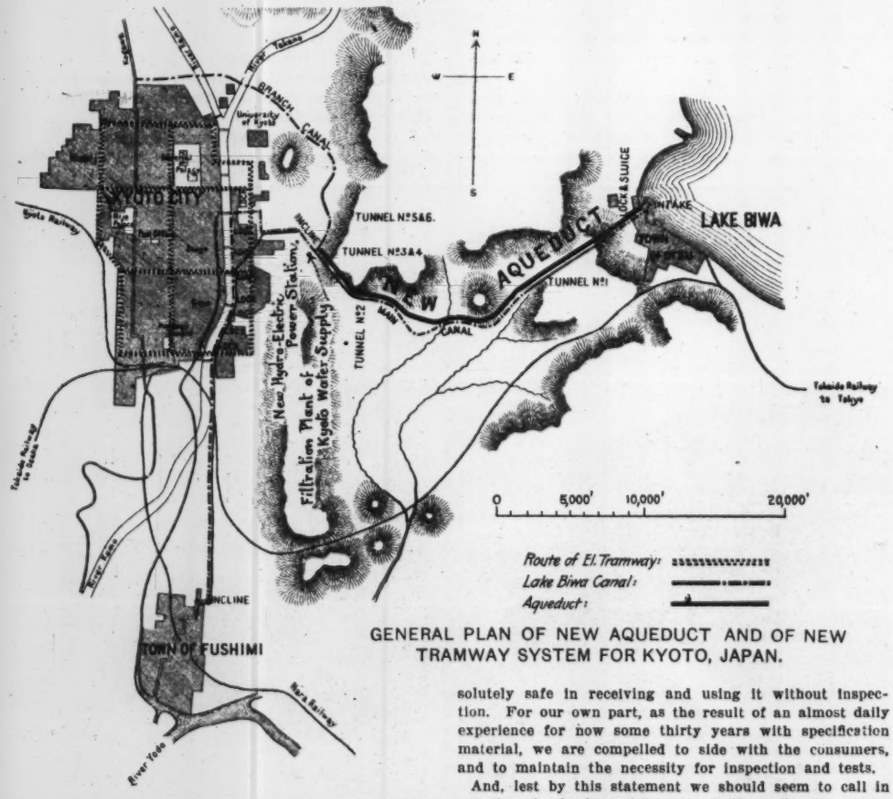
widening the streets. The length of the system is 15 miles of double line. Most of the system will be opened to traffic in 1910, and the rest will be completed three or four years later on account of the time required in widening the streets. The said hydro-electric power plant already described will supply electric power for the tramway.

These municipal works will cost ten millions of dollars, but the municipality is expected to have very rich revenue from them.

THE ENFORCEMENT OF SPECIFICATIONS.*

By CHARLES B. DUDLEY.†

In the early days of specifications they were little more than attempts on the part of the consumer to tell the producer what he wanted. Some specifications which we have seen consisted of only a few lines, and these either related almost entirely to a brief description of the material desired or embodied some simple tests. Indeed, in the preparation of such specifications there is reason to think that the consumer himself had meager information in regard to the material he was describing,



GENERAL PLAN OF NEW AQUEDUCT AND OF NEW TRAMWAY SYSTEM FOR KYOTO, JAPAN.

and perhaps only knew with certainty that the material he was receiving was unsatisfactory and that he wanted something different.

Later on, as knowledge of materials increased, as methods of testing became better understood and more completely worked out, as those who were making specifications learned by experience how difficult a matter it was to draw a satisfactory specification, and especially after it became the custom to consult the manufacturer in making the specification, it took on a new meaning. At first it had been a demand; it now became an agreement. At first it had ofttimes, perhaps, been promulgated with something of a feeling of superiority by its maker, and received by the manufacturer or producer with a feeling of opposition and antagonism; it now became more of a compromise, and was put forth and received with a much more conciliatory spirit on both sides. From being a species of legal instrument that had in it conditions and requirements that the one who held the purse strings felt that he had a right to insist on, it took on more the nature of a contract, in which the stipulations had practically been agreed upon by both parties in interest.

Looking at the specifications in this light, and assuming, as we must, that business to be successful must be conducted in accordance with the principles of honesty, integrity, and fair dealing, it would almost seem that it would be a waste of time and effort to discuss the subject which we have chosen for this paper: "The Enforcement of Specifications." The specification is a contract, and, as we have said again and again, in any properly drawn specification both parties have had a voice, differences have been harmonized, and the conditions and stipulations have been agreed upon. If, now, men are honorable, and intend to do as they have agreed, as we are bound to assume that they are and do intend to do, what need is there for enforcement? Is it not safe for the consumer to receive and put into use the material which the producer furnishes, without the trouble and expense of maintaining a department, or a corps of inspectors, to protect his interests? Unfortunately the experience of the business world at the present time does not seem to warrant such a procedure. I doubt not there are consumers within the sound of my voice who, if pressed for an answer to our question, would say with a somewhat sarcastic smile that the situation is utopian, and that, with human nature as it is, it is absurd to expect to get what you have contracted for unless people are watched. On the other hand, no doubt an equal number of producers who hear me are entirely ready to assert that they are conducting their business in such a way, and are making and delivering such a product, in their specification material, that any consumer would be absolutely safe in receiving and using it without inspection. For our own part, as the result of an almost daily experience for now some thirty years with specification material, we are compelled to side with the consumers, and to maintain the necessity for inspection and tests.

And, lest by this statement we should seem to call in question the business integrity of the producers, among whom we are happy to number some of our best and most valued friends, let us hasten to say that there are so many conditions leading to the manufacture and delivery of unsatisfactory materials (that is, materials that do not fill the requirements of the specification on which they were bought), which conditions do not involve the business integrity, or the honest intention on the part of producer to do as he has agreed, that we are sure no one need feel aggrieved at the establishment and maintenance by consumers of devices for the enforcement of their specifications.

CONDITIONS THAT MAKE INSPECTION AND ENFORCEMENT NECESSARY.

It would of course lead us too far to inject into this paper a discussion of business honesty on high moral grounds. Such a discussion is foreign to our present purpose. The basis of our discussion is the business truism that a transaction is satisfactory when both parties get benefit from it and both parties are satisfied. No one believes more devoutly than we do that with few exceptions, so few as to be almost ignorable, producers in general prefer to do an honest business at a fair price and profit, and that they always would do so if it were not for certain conditions. What then are some of these conditions?

First, however, in order to avoid constant repetition of the words "materials according to specifications," and "not according to specifications," let us agree that the former may be properly designated as "satisfactory materials," and the latter as "unsatisfactory materials," the view point obviously being that of the consumer. is being granted, the first condition that we will con er which leads to the tender of unsatisfactory material s: improperly worded or unreasonable specifications. is obvious that the view point of those having to do h either the making or carrying out of specifications b g different and in a sense antagonistic, since their inter s are naturally and legitimately opposed, the mea g which they attach to words will be different and h parties may be equally honest. We knew of a e once where a lumberman agreed to buy a large num r of logs from the owner of a valuable timber tract on he simple specification that only two logs from a tree sh ld be delivered. Imagine his surprise, when the logs e gan to come in to find them small, tapering, and ful of knots. On remonstrating, he was told that, just exa ly as the specification called for, only two logs per tree were being delivered, and he was invited to look at his contract. An inspection revealed the fact that, although the lumberman undoubtedly had in mind, when the specification was drawn, that he should receive two logs from the butt of each tree, the important word "but" had been left out; while, on the other hand, the owner of the lumber tract had unquestionably read into the specification when it was presented that under it he would be entitled to deliver two logs from the top of the tree, just as he was actually doing. It may not be unwise to add that a contract covering two butt logs from each tree was somewhat unusual, that the price was lower than would have been expected for such logs, and that as a matter of fact the case never came into court. In like manner an unreasonable requirement in a specification may lead to the same result. Our friends the steel manufacturers are constantly being presented with specifications containing stipulations which it is impossible or at best only occasionally possible to fill. Those who have made these specifications have, we fear, neglected one of the prime requisites of a good specification, viz., to consult with, and, on certain technical points be guided by, the best manufacturers. And further it may be urged that a producer has no right to take a contract under a specification that contains a requirement that he knows he cannot fill. While this is true abstractly, it must be remembered that the producer is in a rather delicate situation. If he remonstrates against the unreasonable requirements he probably loses a customer. If he refuses to take the contract with the unreasonable requirement, and as matter of fact it is well known that this is done again and again, he not infrequently makes an enemy of the engineer or expert, who simply has a crotchet in his head but is otherwise a very good fellow and who later may be valuable, and so the contract is taken even with the unreasonable requirement and with the thought in mind of getting along with the matter in the best way possible if any difficulty should arise. The producer, we fancy, knows that he is making good material and giving good value, and with this thought condones himself for his seeming breach of contract. As far as our subject is concerned, we cannot but feel that an improperly worded or an unreasonable specification is a most potent cause for the tender of unsatisfactory materials.

Again the mistakes of subordinates are a frequent cause for the same difficulty. An illustration of what we mean by mistakes of subordinates will make the matter clear. Some years ago a railroad company placed an order with a most reputable firm for fifty barrels of the best grade of lard oil, known at the time as "Extra" or "Prime," the other well-known grades being Extra No. 1, No. 1, No. 2 and No. 3. The difference in the cost of the extreme grades was ten to fifteen cents per gallon. The order was what is technically known as a "Rush" order, that is to be filled as soon as possible. In due time the material arrived at destination and was sampled and tested in the regular way. The test showed the material to be No. 3 oil, and the shipment was promptly rejected and returned to the shippers. They made a careful examination of the shipment barrel by barrel, and found that 45 barrels contained oil of the proper grade and of unexceptionable quality, while the five barrels were No. 3 grade as the test had shown. On asking for an explanation, the foreman of the works said that when the order was received he only had 45 barrels of the proper grade in stock, and it being a rush order he put in five barrels which he knew to be inferior, hoping that the matter would escape detection.

It may be of interest to know that in this case the shippers actually felt themselves aggrieved, and claimed that since they had to pay return freight on rejected material the 45 barrels of good oil should have been retained and only the five barrels of inferior oil should have been returned. The purchasing agent, on the other hand, very mildly but very firmly reminded the shippers that the order which he had placed with them did not call for any No. 3 oil, that there was a difference in price of at least $5.00 a barrel between the two oils, and that if perchance the sample tested had come from one of the barrels of good oil, the shipment would have been accepted without question, and it would have been a clear case of successful fraud by which they would have profited. But there was considerably more in this than was brought out by the purchasing agent. Extra or

*Presidential address to the American Society for Testing Materials, delivered at Atlantic City, N. J., June 20, 1907.

†Chemist, Pennsylvania R. R., Altoona, Pa.

per lard oil is used by railroad companies almost exclusively in making what is technically known as "Signal Oil," that is, oil used in signal lights and in train lanterns; also the safety of trains and even the lives of passengers depend on the reliability of the signal oil and perhaps more important still, a signal oil made of No. 3 lard oil is utterly worthless and unreliable. The lanterns will commonly go out and fail completely within two hours after new trimming and filling with such oil. The bearing of all this on the necessity for the enforcement of specifications is too evident to require comment.

It would lead us wide of our proper field to raise and discuss the question whether such a mistake on the part of subordinates, as we have cited, is ever made with the knowledge and consent of the principals or not. We have heard it intimated that such transactions are fairly common and that, when such a case comes to the knowledge of the office or the principals, one of two things is apt to result: If the shipment has gone through, the transaction is closed, and no questions have been raised, the subordinate is usually not reprimanded, but on the contrary gets a smile of approval. On the other hand, if the fraud is detected, and trouble and loss result, the subordinate not infrequently suffers.

Perhaps you will bear with me while I give another out of the many that might be cited of the conditions leading to the tender of unsatisfactory materials, even though those who are doing so have a sincere and honest intention of fully meeting the requirements. This condition is that commercial processes do not always yield what is expected of them. Something in the materials used, or in the processes employed, gives a product that is unsatisfactory, notwithstanding the producer supposed he had done everything that he could to secure a successful result. Let me give an illustration. Some years ago in our laboratory at Altoona, we examined in the regular way a sample representing a shipment of phosphor-bronze bearing metal from a firm whose business reputation and character were simply above reproach. This material, as is well known, is an alloy of copper, tin, lead and phosphorus, the percentages of each constituent being fixed within narrow limits by the specification. The analysis showed copper, tin and lead within the limits, but no phosphorus, and the shipment was rejected. This was followed by a visit from one of the principals of the firm, who maintained that he had actually purchased in the market phosphor-tin at a high price, and used it in making this very material, and that the fact that we found no phosphorus was a mystery to him. It was asked if he knew by analysis how much phosphorus there actually was in this so-called phosphor-tin, since our own analyses of the material in the market showed not over a third or at most half of what was claimed. He confessed that no analyses had been made, but stated that he bought the material on a guarantee that it contained ten per cent. He was then asked if he knew that there was a loss of phosphorus every time the alloy was melted, and that with careless foundry manipulation this loss might readily amount to all the phosphorus he had actually added. His reply indicated haziness on the subject, coupled with a desire to learn. A few suggestions were eagerly noted, and apparently well applied, since the same firm subsequently made and furnished to the road large quantities of entirely acceptable material.

And so we might go on quite at length, detailing condition after condition that leads to the tender of unsatisfactory materials, some of them perhaps not quite as free from suspicion as those already mentioned, but all of them emphasizing the necessity, on the part of the consumer, of apparatus and appliances for testing, and a rigid enforcement of specifications. It will perhaps be sufficient if we enumerate without special illustrations or comment, a few more of these conditions. A contract taken at too low a figure is a fertile cause of what we have agreed to call unsatisfactory materials. Under stress of competition, agreements are made that if carried out strictly in accordance with the specifications would result in loss, or lack of reasonable profit. Again, strange as it may seem, a very large number of manufacturers of commercial products as a matter of fact do not know the characteristics of their output. They have been making and selling their staple for a period of years, it may be, and as long as the consumers accepted the material and raised no questions they themselves saw no need of making tests and experiments, except perchance such as would lead to diminution of cost in manufacture. Accordingly very little or no knowledge was obtained of those qualities of the material which are of most interest to the consumer. It has been our custom for many years, as is well known, to send our proposed specifications to the manufacturers for criticism before they are officially issued, and we have again and again received from producers, in reply to the question whether they could make a product that would stand the tests of the proposed specifications, the answer that they could if anybody could. There was apparently absolute lack of even the most rudimentary knowledge of those qualities of their product which were of the most interest and importance to the consumer. And yet, without this knowledge, contracts are taken and shipments made. What more natural than that the material should be unsatisfactory in the technical sense of the word?

Again the tender of unsatisfactory material is often explained, after it has been tested and found wanting, by the statement that, although it may not quite fill the requirements, it still is good material and will do the work. Of course, it takes but a moment's reflection to lead any fair-minded person to the conclusion that this statement is not at all the question at issue, and that if the consumer had been willing to use a material that is, in the language of the shops, "just as good," he would have specified such material, and obtained the benefit of a corresponding variation in price.

Two more conditions leading to unsatisfactory materials may perhaps wisely be mentioned before we leave this phase of our subject. It not infrequently happens after a contract has been made, that unexpected and wholly unforeseen difficulties arise in securing raw materials from which the product in question is made. An unexpected demand has sprung up for that kind of raw material, making it scarce in the market, or the parties with whom the producer has a contract for his supply repudiate the contract, or there has been an accident or catastrophe affecting the supply. The producer therefore finds himself in the condition that either he is unable to make deliveries as he has agreed to do, or he must (or thinks he must) make deliveries of his product containing such raw materials as he can get, with the accompaniment of that brood of troubles that arise when the tests show unsatisfactory materials. Not once but many times has this situation been prominent in the course of our work at Altoona; and there is one phase of the matter which we have found it most difficult to understand. The producer goes ahead and makes up his product from inferior raw materials, and makes shipments, knowing that there will be trouble; and then when the trouble arises, he explains and asks for leniency. The query in our minds has always been, why does he not explain and ask for leniency before he makes and ships the unsatisfactory material? If we may trust our experience, a frank statement of the situation beforehand would be far the wiser course. We fancy the reasons for the procedure actually followed will ever remain one of those business mysteries which are incomprehensible to the lay mind.

Finally, a most common and pestiferous cause of the tender of unsatisfactory material is the statement that delay must follow if these unsatisfactory materials are not received and used. We say pestiferous, because of all the causes leading up to the tender of unsatisfactory materials, this one seems to us to have the least foundation of equity to rest on, and to be the one that smacks most strongly of a deliberate effort to force through an acceptance regardless of quality. We are quite well aware that emergencies may arise in the case of those who are furnishing materials, which emergencies may fairly be regarded as legitimate causes for an unsatisfactory product. We have already discussed a number of such. On the other hand we have so many times had occasion to feel that at the last minute materials are tendered which the parties had known for some time, or at least might have known, were inferior and not satisfactory, that the argument "there will be delay if you do not accept this that we tender" is deprived in our minds of a very large percentage of its force. It would be infinitely better, it seems to us, not to make shipments, and either to put some of the energy now employed in trying to get unsatisfactory shipments accepted into making and furnishing satisfactory material, or to make a frank statement of the situation to the consumer beforehand, and abide his decision. Such a statement would do much toward smoothing down and removing some of the roughnesses and inequalities of the road which the producer and consumer are trying to travel together toward the goal of a successful financial transaction.

Let us now turn to another phase of our subject. If we have succeeded in what has been said, it is evident that there is necessity for the enforcement of specifications, and that, too, without assuming that men are dishonest, or do not intend to do as they have agreed. Under present commercial conditions and with our present knowledge of the properties of materials and of the processes by which they are made, it simply would not do for the consumer to leave his interests wholly in the hands of the producer. Each must look out for his own interests, and be prepared to defend and maintain them. Perhaps we have said more than is necessary on this point, but the practice of buying and using materials on the reputation of the maker is so deep-seated and widespread, and has for so many years been the refuge of engineers in cases of failure, that perhaps the subject will safely bear elucidation at a little greater length than would otherwise have been admissible.

HOW TO ENFORCE SPECIFICATIONS.

But how shall specifications be enforced? What are the essentials of successful enforcement? We reply, first, the examination and testing of the material tendered must be so planned as to be efficient and leave no loopholes for evasion or for substitution of inferior materials. In the case of some substances every shipment must be tested. In the case of others, as for example, materials that are produced in heats, or are stored in tanks or bins, the tests deciding their fate may be construed to cover the whole amount, even though there may be a number of deliveries. The essential feature is that each test or lot of tests shall cover a definite amount of material, and that nothing shall be left to the honesty and good intention of the producer or shipper. If we are going to trust the producer in one detail we may as well trust him in all. The strength of a chain is the strength of its weakest link. No universal rule can be given, but assuming that the specification is wisely drawn and provides only essential tests, these tests must be so applied as reasonably to cover all the material that is delivered.

SAMPLING.—Again, since it is clearly impossible, except perhaps in the case of proof strains, to apply tests to all the material in the shipment, it is obvious we must rely on tests of samples, and this brings up the question of sampling. Upon this point several rules are clearly applicable. First, a representative of the consumer must always take the sample. This is in accordance with the principle already enunciated, that it is not reasonable or proper or safe to trust the producers in anything by which the validity of the tests might be affected. Not once but many hundred times have we been asked to allow the shippers or producers to send a sample and accept a shipment on its examination. The request was undoubtedly made in good faith, and with no other desire than to facilitate the transaction. Perhaps it is needless to say that our belief in the facility with which unintentional mistakes would be made, and a sample better than the average of the shipment be sent, has always led us to positively refuse such requests.

Second, the sample must be representative of the whole shipment or lot under test. This point is usually provided for in the specifications and does not here require special comment. Nor is it essential perhaps to remark on the necessity that the sample should represent a definite amount of material, since this is also provided for in the specifications. We may, however, be permitted to say that some specifications that we have seen seem to us to assume greater uniformity in the product made in successive similar operations than actually exists in the material. If it were at all possible to avoid it, we would not like to accept articles of steel made by the Bessemer process, especially where strength and safety are involved, without a test of each blow.

A third point in regard to sampling has a more direct bearing on our theme, the enforcement of specifications, viz., the sample should be taken at random, and not always from the same place. We have many times been surprised to find out how intimate the knowledge on the part of the shipper or producer soon gets to be of the practices of the consumer in sampling. Apparently the producer thinks it is just as fair that he should know all about the consumer's use of his material, as that the consumer should know all about his manufacture of it. And this we are quite ready to concede. But now if in sampling a carload of oil, the barrel next to the door is always chosen by the inspector, or if in sampling a pile of axles, the one on top is always selected, or in picking out a spring for test from a lot assembled and offered, if the one nearest at hand is habitually taken, it is perfectly evident that an opportunity is afforded for one of those unintentional mistakes of workmen or foremen, that would result in the best material always being tested. It would take us too far away from our subject to discuss here the bearing upon these unintentional mistakes of the practice which is so common in many establishments of paying the subordinates, nay even the whole manufacturing organization perhaps, in proportion to the amount of successful output. We cannot but think, however, that ingenuity in sampling is a legitimate and reasonable offset to this practice, and that it is as important that the inspector who takes the samples should be full of suspicion and scientific doubt as that testing machines should be reliable, or that a chemical balance should give accurate weights.

As showing how failure to comprehend the whole shipment in the sampling may result in disaster, and at the same time illustrate the unintentional mistakes of workmen about which we have already said so much, let us cite an incident. A lot of bronze castings were being furnished for use in locomotive construction. The order was a large one, and shipments were made from time to time. The inspection force was pressed with work, and, let it be confessed, was not quite as much permeated with suspicion and scientific doubt as should have been the case. The bronze was bought on definite chemical specifications, and from each delivery enough sprues were broken off from various castings by the inspector to properly sample the material. These samples were used for the analysis. Deliveries were made usually about three times a week, and the inspector was sent for to inspect and sample the material whenever a delivery was ready. It was explained to the inspector that it would greatly facilitate the work of the foundry if he would allow say three-fourths or more of the cast-

ings to have the sprues broken off and used over again before the regular sampling was done. They would leave enough sprues attached, say to a quarter of the castings (nothing very definite as to the number of sprues to be left attached was promised) so that he would have abundant chance for selection. In the goodness of his heart the inspector allowed this to be done. A number of shipments were made, sampled, tested, and accepted in this way. Some suspicion having arisen later in the minds of those higher up than the inspectors in the testing organizations, some twenty full size castings, all selected from a large number of those from which the sprues had been broken off before sampling, were sent for analysis. The analyses showed that in some manner not explained every one of the samples from the castings bereaved of their sprues by the foundry force, were not only not according to the specifications, but showed unmistakable evidence of having in their composition large percentages of inferior scrap. It is perhaps needless to add that from this time forward, after the inspector had been changed, the sprues were all allowed to remain on all castings until the sampling was finished.

This brings us to the last requirement in sampling which we will discuss, viz., the sample material should, as far as possible, not remain in the hands of the producers after it has been sampled. The equity of this practice will not we fancy be called in question; the actual carrying out of the rule is not always so easy. Materials that are sampled and tested after they arrive at destination present no difficulties. We have known of refusals to ship until after the material had been tested and accepted, but when it was explained that it would be practically impossible to send inspectors to sample every shipment of every kind of material before it was started on its journey to the service for which it was intended, such refusals have usually vanished. Moreover, the refusal to ship has always seemed to us to argue either a lack of knowledge of the characteristics of the material that the shipper is tendering, or a well grounded fear that it would not stand test. Also in the case of materials such as springs, alloys, &c., which can be inspected and sampled, and then loaded at once, there is no difficulty, but in the case of materials which cannot be so treated, or which must be stored, the matter is more serious. In such cases, marking in such a way that the marking cannot be defaced without showing it, must always be practiced. The chances for unintentional mistakes are too numerous, and the fact that such mistakes do actually frequently occur is too common to permit of any uncertainty on this point.

Before leaving the subject of sampling, perhaps you will bear a word on the question whether a sample taken with all the known precautions does as a matter of fact actually represent the shipment. The sample is but a very small fragment of the shipment, and a doubt fairly may be felt as to whether the whole shipment is like the sample. It is obvious that if the specification is intelligently drawn, all the variations in the material due to uncertainties in the process of manufacture or unavoidable errors of manipulation are provided for in the sampling which it directs. This leaves only intentional or unintentional variations introduced by the producer to be provided against. Our position in regard to these has always been that if the producer was willing to take the risk of our getting our sample from one of these intentionally inferior parts of the shipment, with the rejection which would inevitably follow, we were willing to take the chance of getting a sample from a better part of the shipment, with the consequent acceptance of some inferior material. Moreover, in cases of reasonable doubt we have a number of times sampled every part of a shipment, and are strong in our belief that very few commercial men would persistently offer material portions of which they knew to be inferior.

THE QUESTION OF RETESTS.—But again let us discuss another phase of our theme. Let us assume that the specification has been wisely drawn, that a shipment has been properly sampled, and that the tests show that it does not fill the requirements. What is the next step? As a matter of fact in our own daily work but one thing is ever done: the material is rejected. None of our specifications provides for a second or third sampling and corresponding tests. Our theory is that the material ought all to be of the grade called for by the specifications, since this is what the consumer has bargained for, and if this is the actual fact one sample is as good as fifty. We are quite well aware that there are many specifications in force which provide for second, and if need be third, tests, the fate of the shipment to be decided by the majority. But this has for a long time seemed to us to be a survival of the crude early days of testing, when neither producer nor consumer knew much about materials, and which it is high time should be banished forever. If a specification is so severe that only two-thirds of well made material will stand test, the specification should be changed; and if a manufacturer can only make a product only two-thirds of which will stand test, he should either learn how to improve his product or go out of business. Testing was never intended to be a device to bring about the acceptance of inferior material; but quite the contrary. Moreover from three samplings and tests, it is but a step to five or seven or nine, and perhaps if sampling and test is long enough indulged in, a majority may ultimately be found which will always bring acceptance of the material. Surely the interests and responsibilities of the consumer cannot be trifled with in this manner.

But some one says: Are you so sure that you are right in your single test that you feel that you are on firm ground in rejecting material and cutting off all chance for further tests? We reply that that is quite another matter. Retesting because the material fails, no question being raised in regard to the reliability of the tests, is entirely different from a retest because there is reason to think there is something wrong with the sampling or testing. In this case the burden of proof is on the producer, and it is incumbent on him to show reasonable ground for reopening the case. On the other hand, it is equally essential that the consumer should welcome the investigations of the producer, should throw everything open to him, and give him every facility for satisfying himself that no injustice has been done. There is no room for a Star Chamber in the enforcement of specifications. In our own laboratory we always keep the sample of every rejected shipment for a month, and are always ready to give the producer half of our sample for verification purposes. Moreover, we have often said to shippers who were interviewing us over rejected material, "You may follow your material from your works to destination, you may see the sampling, may follow the sample to the laboratory, and either by yourself or your technical representative be present and watch the whole operation of the testing; and finally, here is half the sample on which we have worked. Put it in the hands of any reputable chemist, and if he does not confirm our results, we will take up the question with him, and find out who is in error." Our sincere desire is to get at the truth, and we cannot put it too strongly, there should be nothing unfair or secret or arbitrary on the part of the consumer in rejecting material. On the other hand, the sampling and testing being fair and honest and reliable, there should be but one sampling and testing, and no retests.

DISPOSAL OF UNSATISFACTORY MATERIAL.—Closely related to the point we have just discussed is the question of the use of rejected materials. It is safe to say that hundreds of times during the past thirty years we have been asked, "Yes, it is true the material does not quite stand test, but cannot you accept and use it?" And only a little less frequently the same request has been made of those higher in authority in the organization. The arguments usually used are, "The material will give you good service, not quite as good as if it had stood test, but still on the whole fairly satisfactory." Also, "We are good friends of yours, and would do the same for you." And still further, "We are very large shippers over your line, and think some concession is due to us in view of this fact." There is apparently complete failure on the part of those using these arguments to comprehend the position in which they are placing the officer to whom these requests are made. Let us see if we can look at the matter from his point of view. It takes but a moment's reflection on the part of any fair-minded person to enable him to see that to grant the request means a complete breaking down of the specifications. The officer in question is usually responsible for the specification. He has made and issued it, and that too after careful consultation with those who are to furnish the material. The requirements of the specification have been agreed to, and a contract has been made with the purchasing agent or other officer to furnish material that would stand test. If now the specification is to be waived in one case, why not in all; and what then becomes of the specification? Still further, a shipment of the kind in question once accepted becomes a precedent for the next case, and so on ad infinitum. Moreover, apparently also another and very important point is forgotten, viz., it is simply unfair and unjust to those who are furnishing material which *does* fully meet the requirements to accept shipments from others who fail in this respect. Much of the obloquy, which is so rife at the present time, affecting those in authority in large organizations using large quantities of material, is legitimately and reasonably based on cases of this kind. It is claimed, and as it seems to us justly so, that certain parties have a pull, and are able to do business with the organization in question, while others who are striving to be absolutely straightforward and honest, and to do as they have agreed, are entirely unsuccessful. Moreover there is another phase of the case. It may chance that the rejected material is of such a nature that the use of it would only involve a slight financial loss. This point we will refer to in a moment. But again on the other hand, the rejected material may be of such a kind that the question of safety to passengers, or risk to human life, is involved in its use. In this last case, it seems to us that there can be but one answer to the request to use unsatisfactory material, and that is, "Nothing could induce us to accept and use this material." And in the case where only a money loss is involved, as has just been cited, we are clear that there is only one condition under which it is at all [illegible] missible to accept and use rejected material. It has [illegible] a puzzle to us how completely manufacturers and [illegible] pers lose sight of this condition. If among the [illegible] ments used to get the rejected material accepted [illegible] shippers would only urge, "It is true the materi[illegible] not quite what we have agreed to furnish, and in [illegible] of this fact we will deduct a certain amount from [illegible] bill," their case would, as it seems to us, stand on [illegible] ground and might have a reasonable expectation of [illegible] cess. Fairness and the ultimate satisfaction of [illegible] parties to a transaction is the only basis upon wh[illegible] successful business can be continuously carried on.

This whole matter of multiple tests, retests, and disposal of unsatisfactory material can as it seems to be summed up in a few words. Multiple tests are pernicious and should be abandoned. Retests including sampling should never be made unless there is reasonable evidence to think there is an error somewhere in the first test, and to decide this point every reasonable facility should be furnished by the consumer to the producer to enable him to satisfy himself. Shipments of material once fairly rejected should never be accepted and used if the material is of such a kind that safety or risk to human life is involved. And finally, it is suicidal and brings with it a train of almost unmanageable subsequent conditions, to accept rejected material in which only commercial considerations are involved, unless there is some abatement in price.

ERRORS AND VARIATIONS OF TESTS.—A number of other points involved in the enforcement of specifications might be discussed, but I fear I have already wearied you. Perhaps you will bear with me while I very briefly touch upon one or two more. It not infrequently happens that when the tests are applied to the sample it is found that it almost but not quite fills the requirements. What should be the procedure in such a case? The answer is not quite so easy as might seem at first sight. It is well known that the ruling which prevails in many locations, especially abroad, is that the material fails and should be rejected. For example, suppose the specification requires not above 0.040% of phosphorus in the steel, and the analysis shows 0.043 or 0.045%. Shall the material be rejected? It is plain that the accuracy of chemical work is involved. Now it should be confessed openly and plainly that no test gives absolutely accurate results. One of my old instructors used to say, "No chemist can make an absolutely accurate analysis. Even though the chemist himself was infallible, the methods will not give absolute results. There are chemists who can work near enough to accuracy so that their results are useful, and there are others who cannot." And the same is true of physical tests. Testing machines are not absolutely accurate, and strictly accurate measurements are very difficult to make. How then shall these inevitable inaccuracies be handled?

In our own laboratory no shipment is ever rejected until the test has been duplicated, and sometimes three or four tests are made. But this still leaves the unavoidable small inaccuracies unprovided for, and they must be provided for in some way, as not rarely acceptance or rejection turns upon them. Two ways of meeting the difficulty have been sugegsted. One is to have it a part of the specifications, and to have the producers clearly understand it, that the limits of the specifications cover the inevitable and unavoidable errors of testing, that is the manufacturer should work far enough within the limits of the specifications so that the inevitable and unavoidable errors of testing would never lead to the rejection of a shipment. The other way is to make the limits of the specification sufficiently narrower or wider, as the case may be, to cover these unavoidable and inevitable errors of testing, and then allow for them in deciding whether to accept or reject. The latter procedure is the one we have always followed in our laboratory. An illustration will make the whole matter clear. For certain purposes, steel containing 0.040% of phosphorus will give us perfectly satisfactory results in service. But knowing as we do that chemists will differ, and that there are inevitable and unavoidable errors in the analysis, we make the upper limit of phosphorus in the specification 0.03%, knowing that such steel can readily be obtained in the market without undue hardship to any one. It is evident we have by this procedure sufficient margin to cover inevitable and unavoidable errors in the determination, without raising questions which involve contention and hair splitting. It is infinitely better, it seems to us, to so draw the specifications that the service will be protected by a sufficient margin to afford good strong fighting ground, and then when a rejection is made stand by it to the bitter end. One of the most used rules of our laboratory is: Never reject a shipment unless you know beforehand that so far as the figures of the test are concerned, you will win in the contest which may follow the rejection.

Again let us suppose that a shipment has been wrongly rejected, and that the shipper has been put to expense in regard to it. In any requital due him for this loss, or must he regard it as one of the inevitable expenses of doing business? We answer unhesitatingly that in the case supposed there is only one thing to be done,

at hat is for the consumer to make good the loss due to e erroneous rejection. It is a poor rule that does no work both ways.

should like to discuss several points further in co ection with our theme, notably, What shall become of jected material? How far has the consumer a right to otect himself against such material? And especially ha e a right and is it good policy for him to so mark re ted material that it cannot be offered again? Still fu ier, we should like to bring before you the question as who shall make good the annoyance and frequent m y loss which are experienced by the consumer due to jected materials. It is always annoying and often ne sitates expensive delays and rearrangements to re- je a shipment. Also what penalty if any, should the pr ucer pay, to requite the consumer for this annoyance an loss. Our subject is not nearly exhausted, but we ha already taken too much time.

ear with us while we conclude by presenting very br fly a problem which has had lodgment in our own br n for quite some time now, and which recent events in gard to certain materials have seemed to force into pr inence. It is plain that in using materials in those co structions which involve safety in the railroad sense or risk of human life in the public sense, there is a qu stion of responsibility involved. If rails are defective and break, if an accident with loss of life results from the use of poor material in car construction, if a bridge falls and produces a disaster due to inferior materials, or a building collapses from the same cause, it is clear that some one should be held responsible; and since there are but two parties involved in the materials, viz., those who make them and those who accept and use them, it is difficult to see how one or the other of them is going to escape the responsibility. Now our problem is, which of the two in equity should be held responsible? It is perhaps hardly wise at this time to attempt a definite answer. Much might be said on both sides, and probably no two persons, certainly neither of the two parties most interested, would give the same answer. But there is a phase of the case which we would like to present. It is well known that in the earlier structural work, when safety was involved, there was no testing worthy the name, and materials were bought and used on the reputation of the maker. Fortunately, the constructions in most cases had a high factor of safety. When disaster did come, if it was due to defective materials, it was explained that the materials used were from those of the highest reputation in the business, and that no one could really be held responsible. But at the present time conditions have changed. The knowledge of the properties of materials of construction has increased, methods of testing and testing appliances have grown up in delightful profusion, and it is to-day entirely possible, we feel safe in saying, for an engineer to be reasonably sure that defective material does not go into his structures. We waive here the discussion of commercial considerations as affecting the use of materials. If it is shown that these have led to the use of defective materials, the moral responsibility for loss of life must certainly go to the one who has allowed commercial considerations to have such undue weight, be he either the maker of the material or the one high in authority who has allowed it to be used. But the point we want to make is, in view of present knowledge and present means and appliances for testing, are engineers or their principals any longer entitled to offer as an excuse for defective materials that they were bought from the best makers? Can they equitably do so? Can they legally do so? Is not the time near at hand when engineers and their principals will be compelled, if not legally, then by force of public opinion, to acquire by the establishment of laboratories and means of testing, by the making and enforcement of specifications, such knowledge in regard to the materials they are putting into structures, as will give the public greater security than it now has against disaster?

A REINFORCED-CONCRETE MILL BUILDING WITH SEPARATELY-MOLDED MEMBERS.

The idea of constructing reinforced-concrete buildings by erecting and assembling separately-cast members has been repeatedly carried into execution, in more or less complete form. In Europe especially this method of construction is looked upon with favor, and several types of patented beam designed to facilitate its application have been put on the market. What is probably the most complete application, however, has just been made in the construction of two new kiln houses by the Edison Portland Cement Co., at New Village, N. J. These buildings were assembled from columns, roof-girders (spanning 50 ft.), longitudinal struts, and roof-slabs, all cast on the ground, and erected very much like a shed-building of timber construction. We are able to show herewith construction drawings of these buildings, and a number of photographs illustrating the execution of the work, which, together with a description of working methods, have been furnished us by the Edison Portland Cement Co.

In order to increase the capacity of the company's mill it was necessary to provide for two additional kiln-buildings to house four 150-ft. rotary kilns. The three existing kiln-buildings

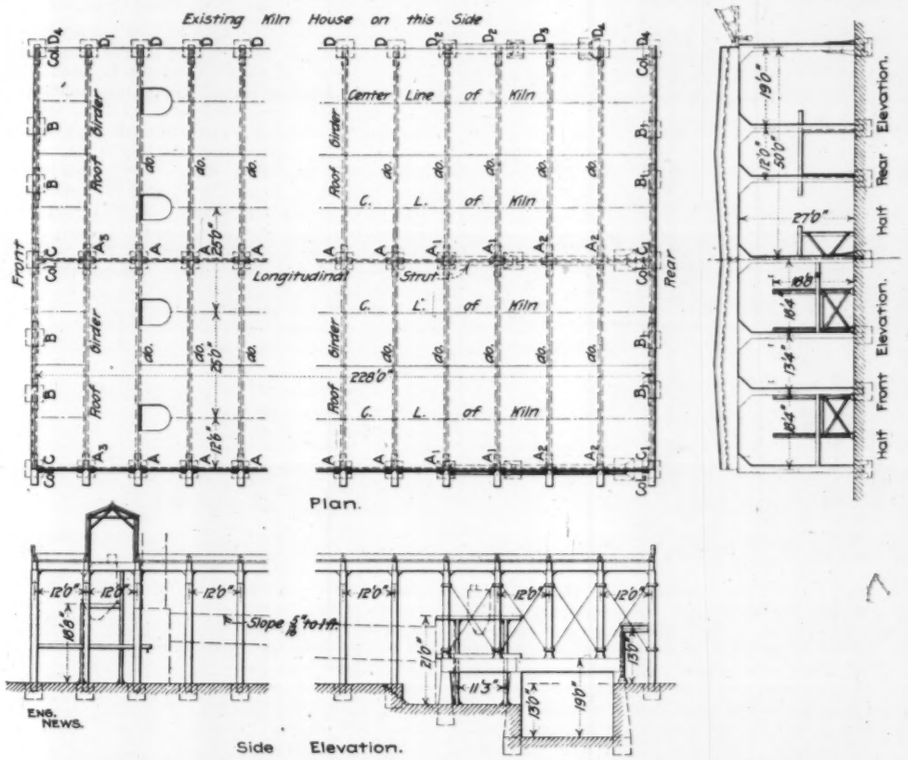


FIG. 1. PLAN AND ELEVATIONS OF KILN BUILDINGS 4 AND 5. EDISON PORTLAND CEMENT CO., NEW VILLAGE, N. J.

were of steel. During the last three years it has been the policy of the company, however, to use reinforced concrete, exclusively, as building material. The engine and boiler house, the stock house, the cooper shop and the coal trestle are all of this material. It was decided to use reinforced concrete for the new kiln buildings also.

Fig. 1 shows fully the general arrangement of the two buildings. They are directly side by side, and form virtually a single structure. The

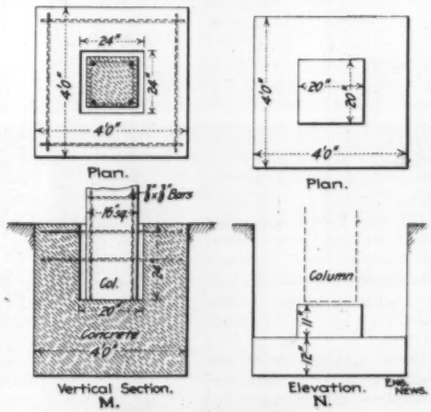


Fig. 2. Column Piers.

M. Pier Used in Center and Right-Hand Line of Columns.
N. Pier Used in Left-Hand Line of Columns, at Junction with Old Kiln Building.

dimensions of each are: Width, 50 ft. c. to c. of columns; length 228 ft. c. to c. and 229 ft. 4 ins. over all; height to bottom of roof girder 27 ft. There are two intermediate floors in the space from the 1st to the 3d and from the 16th to the 17th bents; in the second bay a head-house rises above the roof across the entire width of the buildings. These minor structures are of steel framing, which for the intermediate floors is practically independent of the reinforced-concrete framework of the building. The steel framing of the head-house is bolted to the second and third roof-girders, which have bolt-holes provided for this purpose. Four columns near the rear end are carried on reinforced-concrete girders (built in place) which span the clinker conveyor tunnel.

In the erection of the buildings it was imperative that no falsework should be placed that would interfere in any way with the setting up of the kilns, the coal and chalk feeds, etc. The kilns with feeds occupy about 90% of the floor space. To avoid carrying the roof girders and slabs on heavy expensive trusses of wood, therefore, the buildings were designed to have their several members cast on the ground, to be erected, four to six weeks after casting, in the manner of structural steel. The view on this page exhibits this similarity in striking manner.

The design of the buildings is given quite fully by Figs. 1, 2, 4 and 5. Twisted square steel is used for the main reinforcing bars. In the beams, ½-in. longitudinal rods are placed in the neutral axis and near the compression side, to counteract shrinkage and resist stresses in handling and erection. The columns are reinforced with four rods tied together by straight ties at short intervals; no hooping is used. The concrete is of 1:6 mixture, using run-of-crusher stone without sand. This crushed stone was often very fine, the largest of the aggregate passing a ½-in. mesh, and 10% passing a 200-mesh sieve. This fine aggregate gave no difficulty, however. A roof girder, tested to destruction at four weeks, developed a maximum stress in the concrete of about 3,600 lbs. per sq. in., and a maximum steel stress of 67,700 lbs. per sq. in. The failure was a compression failure, the concrete crushing about 10 ft. from the center. The total deflection just before failure was 9¼ ins. The maximum moment at the breaking point was 11,793,000 in.-lbs. These girders have about 1.45% reinforcement at the center.

The methods of constructing the different members, moving them to the site and assembling them are of primary interest, and the design is subsidiary to the exigencies of erection.

For a base upon which to cast the different

parts of the buildings, concrete slabs 7 ft. wide, 50 ft. long and 4 ins. thick were figured as much cheaper than wood. A foundation of cinder 8 ins. thick was leveled off, thoroughly soaked with water, then well tamped. Upon this bottom the base slabs were cast. Laborers with floats finished the top surface. After a few of the base slabs had been cast, it was concluded that these bases could be made of some use. A third building was being designed to be built and erected in the same manner as the kiln

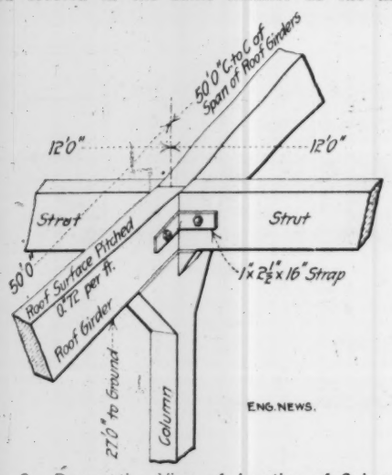


Fig. 3. Perspective View of Junction of Column, Roof Girder and Longitudinal Strut.

buildings, so the dimensions of its roof slabs were changed in order that they might be used for base slabs. By separating the concrete from the cinder with paper, cutting off the slabs to the required length and reinforcing them, each base slab 7 ft. × 50 ft. 8 ins. × 4 ins. could be made up of five roof slabs 7 ft. × 10 ft. × 4 ins., with a 2-in. strip between adjoining slabs. No settlement was noticed in either the one-piece slabs or the slabs made up of the smaller roof slabs. Four 2 × 4-in. strips were cast in the one-piece slab, being driven free of the concrete the day after casting. These strips were to be removed after columns and girders had been cast to allow lifting clamps a hold on under side of concrete.

In arranging the position of the columns and girders on the base slabs, four "A" columns and four roof girders on one slab gave the greatest economy in forms. The four columns were cast first, two in a row with foot of column to foot of column, on the outside of the base slab, just enough space being left between the two rows of columns for four roof girders. Two side forms with forms for the knee braces were used for all columns. Paper was placed on the base slab; the forms, well soaped, were erected over the paper, held by yokes made of two 2 × 6-in. joists spaced 2 ft. on centers with a ⅝-in. bolt 2 ins. above form and a spreader about 18 ins. above the bolt, and stiffened by three braces from the yokes to the ground on each side to keep the forms from shifting laterally.

Seventeen of the sixty columns cast had but one kneebrace (Col. D). These were cast in a different grouping, five side by side, as shown in Fig. 6, the outside and middle columns being cast first, the sides of these columns then lined with paper and used as forms for two more columns.

The main roof girders, 50 ft. in length over all, 12 ins. wide, 24 ins. deep at the ends and 42 ins. deep at the center, were next cast, the outside girders being made first. Using the columns already cast as part of the side form, a short form brought one side to the proper height to make the depth of the girder, a full-height form was used for the other side, and yokes, bolts, spreaders and braces as for the columns were placed to hold the form in position. After the outside girders had been made, a single side form placed the proper distance from the side (paper lined) of one of the outside girders, yokes, etc., gave the third girder. This arrangement left room for one girder to be cast between an outside girder and the girder last cast, using the sides of these girders as forms.

The longitudinal struts, 10 ft. 11 ins. long, by 24 × 8 ins., were cast on the same general scheme as the 17 side columns D, three girders being cast with space left between the outside and middle girders for casting two more.

The roof slabs, 12 ft. × 6 ft. 3 ins. × 4 ins., were cast in tiers, the bottom slab being a roof slab with paper between the cinder base and the under side of slab. The forms used had bevel strips on four sides. The bottom slab was cast with paper on top ready for the second slab, etc. Each slab overlapped the slab below 3 ins. to allow a grip for the lifting irons.

Eight column forms were made, each form being used seven times; three girder forms were made, being used ten times; fourteen roof-slab forms were made and used eighteen times.

A locomotive crane was used to pick up and erect the columns from their casting position. It was found impractical to follow the original plan of removing the 2 × 4-in. strips from the base slab, as the strip was too securely held in place by the weight of the columns and girders above. This had been anticipated, and strips removed in most slabs before casting upon them and the slots filled with sand well tamped. This, however, was of little value as the columns had to be jacked clear of the adjoining girders to get a firm hold on both sides of the under face. A 1½-in. hole 8 ins. deep was then drilled in the center of each end of the column, and a short bar inserted in the hole to give a projection under which a sling from the crane was placed (Fig. 7). This method was found to be both quick and cheap; thereafter a 1½-in. pipe 8 ins. long was cast in both ends of each column, the pipe being removed the day after casting. When ready to erect, the columns were raised and swung clear of the next casting, an 8-in. block placed under each end and clamps bolted on, then loaded on cars, taken to the position opposite the column footings, and erected by the crane.

It was found necessary on the left hand side, adjoining the existing building, to build four columns in place, as the centers of these concrete columns were either on or close to the center line of the existing steel columns.

The elevation of the tops of the columns of the steel and concrete buildings was the same, while a reinforced channel strut between the tops of the steel columns projected below this level. The columns (D) for this side of the building were therefore made 4 ins. shorter than the others to give clearance under this strut in erection. After these columns were erected, plumbed and centered on their footings and the concrete brought to the floor line, the tops of the columns were brought to the correct elevation [illegible] grouting around the strut, the projecting reinforcing bars (see Fig. 6) serving to bind the work to the old.

From the girders across the tunnel [built in place], ½-in. round rods project 12 ins. above girders 1 in. outside the column position; the rods are spaced 4 ins. on centers. After columns had been put in place on these girders a 13-in. form was erected around the base, which was then filled with grout. Diagonal bracing of 1-in. round tie-rods stiffens the columns carried by girders across the tunnel.

In erecting the standard columns (A), the bottom of the pockets in the footings (M, Fig. [illegible]) was brought to the right elevation, the columns set in place, and the 2-in. clearance around the base of the column was grouted to the top of footing. All columns were in place before the erection of roof girders was begun.

The same difficulty in picking up was experienced with the roof girders as with the columns; it was necessary to jack them up to get clearance for clamp under bottom of girder. One-inch hooked eye-bolts 24 ins. long were then cast in the remaining girders 4 ft. from each end, by which the girders could be raised. The girders were jacked up and a 14-in. block was placed under each end of girder. A timber 10 × 12 ins.

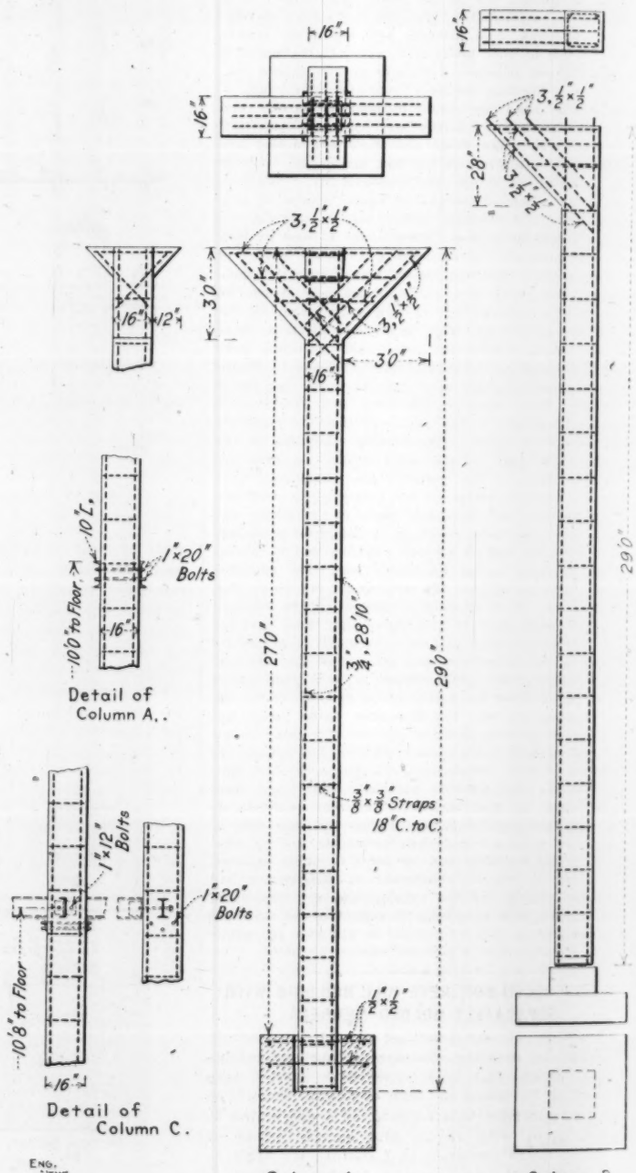


FIG. 4. TYPICAL COLUMNS (A AND D, SEE FIG. 1), AND DETAILS SHOWING METHODS OF ATTACHING AUXILIARY STEEL FRAMING.

by 35 ft. long with a 2 × 6-in. block nailed on each end of the top side was placed centrally under the girder; two 1-in. steel cable slings, held in position at the ends of the 10 × 12-in. timber by means of 8 × 8-in. blocks bolted to the timber, and connected over the center of the girder by a 1½-in. steel clevis, served to lift the girder from the base slab and place it on a flat-car with 7½ × 10-ft. platform. When the first girder was placed on the car, it was noticed that the ends of the girder projecting beyond the 10 × 12-in. timber were acting as a cantilever beam, and after being on the car for about fifteen minutes a small crack was observed on the compression side of girder. Blocks were placed under the ends of the girder to bring the stresses to their normal positions and the slings made to act as a truss by wedging a post under the clevis over the center of the girder, as shown in Fig. 8. This method was used in lifting the rest of the roof girders.

While the lifting rigging was being placed on the girders, four thicknesses of burlap were wrapped around each end of the girder and thoroughly soaked with water, the top of the columns upon which the girder was to be placed being well wet at the same time. The locomotive crane then shifted the car (Fig. 9) to the place of building, where a gin-pole 80 ft. 10 ins. long × 24 ins. at butt end and 17 ins. at top had been erected for placing girders in position. A 50-HP. Mundy reversible hoisting engine operating a ⅝-in. steel cable, reeved six times, raised the girder from the car to its final position (Fig. 10). Mortar of 1:3 mixture was spread about 2 ins. thick over top of columns before the girder was lowered to position, to make an even bearing and to bind the girder to the column. Experiments had been made with briquettes that had been broken and cemented together with neat cement after being under water 30 days. The experiments showed that the second break occurred at the original break and that the strength of the cement joint in the 1:3 sand briquettes was about 60% to 75% of the strength of the briquette. No mechanical tie between girder and column was thought necessary, reliance being placed on the weight of the girder, in conjunction with the adhesion of the grouting.

While the roof girders were being placed, the locomotive crane ran out to the base slabs, picked up a strut and returned, being ready to place it in position when the roof girder was seated. The struts were not grouted in position; an angle made of 1 × 2½-in. flat steel, bolted to the strut and to the roof girder, was considered ample to hold the strut in position (Fig. 3).

For lifting the roof slabs, two clamps were made, clearly shown in Fig. 9. Eight slabs were loaded on a skip car and taken to the gin-pole, where they were hoisted one at a time and placed on a hand-car. All but two of the roof girders were in place before the erection of the slabs was begun. Two rows of 8 × 8-in. timbers were bolted transversely to the roof girders at mid-span, and upon these a standard-gage track for the hand-car was laid. A small derrick on rollers with a 25-ft. boom picked up the slabs from the hand-car and placed them in position. Oakum was packed between the beveled edges of the roof slabs and covered with a rubber cement to the top of slab, to make the roof watertight without the use of special roofing.

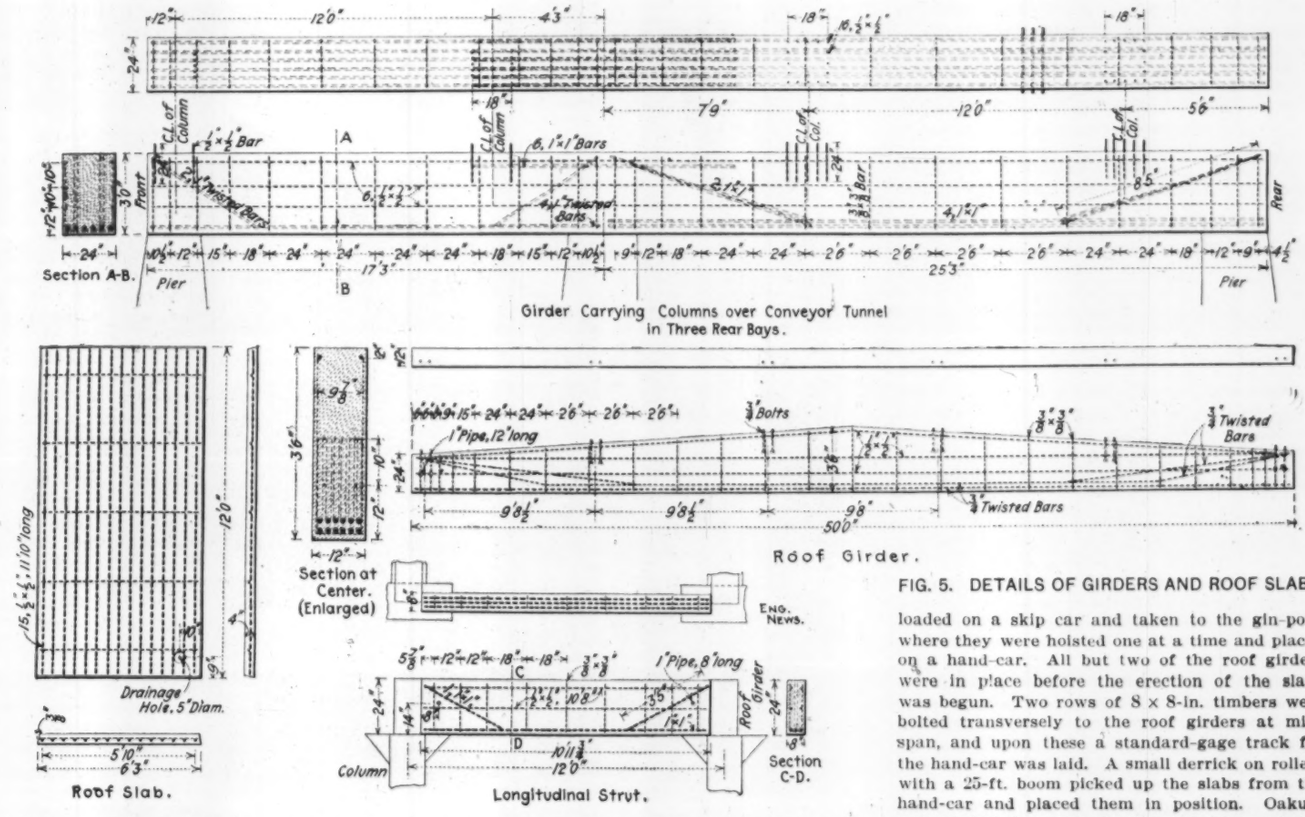


FIG. 5. DETAILS OF GIRDERS AND ROOF SLABS.

As the buildings are directly side by side, and are used for a common purpose, no partitions are put in between the individual buildings. On the outer side of the last-constructed building, corrugated iron sheathing is put on. Bolts for attaching angle girts to carry this sheathing were cast in the columns. When an additional kiln-building is to be added, the iron sheathing will be removed and put on the outside of the new building.

Though the methods used were new and untried, few minor details required changing during the work. The paper used to separate the columns, girders, slabs, etc., from the base slabs and from each other, answered its purpose very well, but the labor necessary to remove the paper from the concrete before erection was excessive. After trying several different kinds of paper, bare, oiled, waxed and soaped, it was found that soaping the paper just before casting gave the best and most economical results.

At present one building is erected and the other is cast ready to erect. As closely as can be calculated at this time, the two buildings will be finished at a total cost approximately $4,000 less than two steel buildings of the same type.

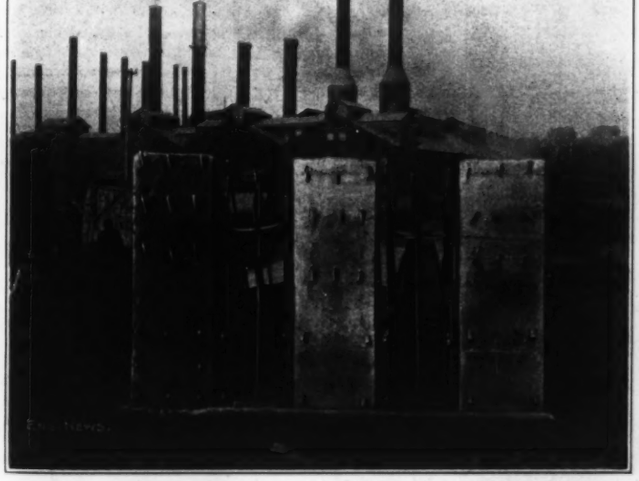


FIG. 6. SIDE WALL COLUMNS ON THEIR CASTING BED.
Three columns completed, and reinforcement for two more in place.

A 1,230 FOOT FALL ON THE MOKELUMNE RIVER, Central California, will be developed by the General Electric Power Co., of Rochester, N. Y., to supply current for light, power and railway service in towns within 300 miles of the station. It is proposed to develop 69,000 HP. by a dam 150 ft. high. This will create a lake flooding about 400 acres. This company will build an electric railway from Lakeport to San Francisco, a distance of 130 miles. The surveys for this road are complete and the right-of-way has been secured. The total cost of the development is placed at $10,000,000. Walston H. Brown and Bros., 45 Wall St., New York City, have taken the contract for all construction work, and plan to begin work in the coming fall.

ANNUAL MEETING OF THE AMERICAN SOCIETY FOR TESTING MATERIALS.

The meeting of the American Society for Testing Materials held at Atlantic City, June 20 to 22, was one of the best, and by far the largest, in the society's history. It might have made a new record in excellence as well as in attendance, but for the fact that the short time allotted to the meeting and the growing congestion of the program came into sharper conflict this year than at previous meetings. Two effects of this conflict—the shorter time available for consideration of each subject, and the reduced intensity of interest due to the volume of the program taxing the individual member's powers of attention—contributed to lessened efficiency of the proceedings.

A quite different condition tended in the same direction, namely, the fact that most of the society's committees are engaged in studies so extensive that they were able to report nothing more specific than "Progress." Three, only, of the thirteen committees presented specifications which they were prepared to recommend for adoption by letter-ballot; and only two of these specifications were actually passed to ballot. However, the record attendance at the meeting, some 250 persons, which is fifty per cent. greater than at any previous one, attests the vitality of the society. Even greater witness to this quality was the high average record of attendance at the individual sessions.

The meeting was held at the Hotel Chalfonte, Atlantic City, N. J., beginning in the afternoon of Thursday, June 20, and reaching adjournment at the close of the afternoon session on Saturday, June 22. Thus it extended over little more than 50 hours. Within that period no less than eight sessions took place, each lasting about three hours; in other words, 24 hours of actual deliberation were compressed into a total period not much more than twice as great. Of course, this was possible only by aid of the device of holding simultaneous sessions. On Friday morning Cement was taken up by a section meeting under the chairmanship of Mr. R. W. Lesley, while at the same time Preservative Coatings and Lubricants were discussed in an adjoining room by a section under President Charles B. Dudley; similarly on Saturday morning one section discussed papers and committee reports on staybolt iron, alloys, springs, tests of steel members, etc., while another took up the subject of Concrete and Fireproofing and Waterproofing

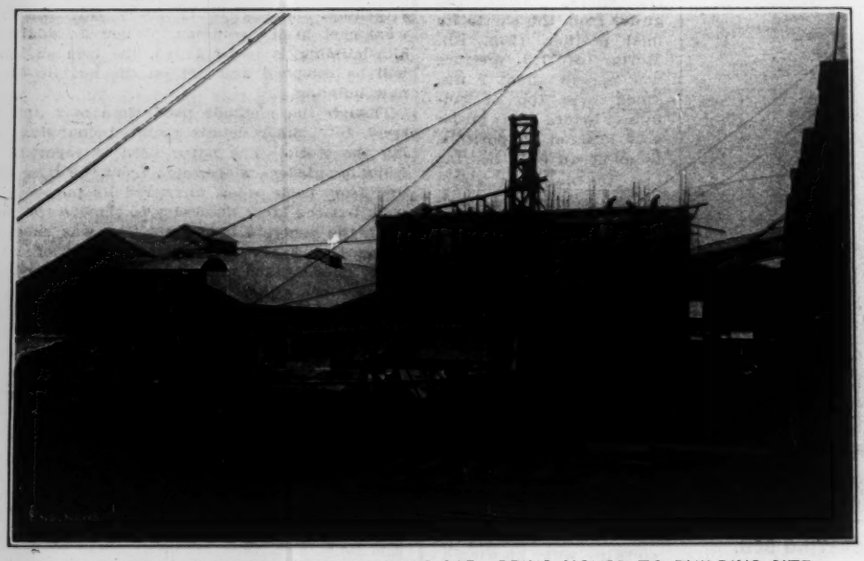


FIG. 8. A 50-FT. ROOF GIRDER ON FLAT CAR, BEING MOVED TO BUILDING SITE.

Materials. As the simultaneous sessions were held in adjoining rooms, it was possible for members interested in the work of both to perambulate from one to the other, hearing portions of the proceedings of both. Some few members tried this, but the scheme is not generally satisfactory, we fancy. Assurances are held out by officers of the society that next year will see such an arrangement of time that it will not be necessary to hold simultaneous sessions. The improvement will be timely.

The two sets of simultaneous sessions do not tell the entire story. A better idea of the crowding of the program is given by these figures: 40 technical papers were presented, 13 committees reported [five of them in more or less final manner], three general addresses were delivered, including the remarkably instructive Presidential address on "The Enforcement of Specifications;" and finally, there was an open discussion of the steel rail question, occupying an entire session, auxiliary to the report of Committee A, which presented a specification for steel rails. Thus, omitting the steel-rail meeting, the other seven sessions had to deal with no less than 55 items, an average of eight per session. The pres ing officer and his associates performed creditab in disposing of this mass of matter on sch le time.

There was a very happy touch added t he meeting, in the form of a subscription dinn at the Hotel Traymore, in honor of Pres nt Charles B. Dudley, w se labors and influ ce have been of inestim le value in placing nd keeping the work of he society on a high pl e. A silver loving cup as presented to Mr. Dud y, partly in recognition of his five years' service as President, but perh ps more as a testimonial of his invaluable pione r work for the developme t and promotion of the study and testing of ma erials, during his lo g connection with the testing laboratory of the Pennsylvania Railroad at Altoona, Pa. This feeling was very clearly expressed in the toasts, especially in the remarks of Mr. Robert W. Lesley, Secretary Edgar Marburg, Capt. Robert W. Hunt, and Professor Mansfield Merriman. The occasion was also made a celebration of Mr. Dudley's conversion to the married state after a long life of bachelorhood, which happy event took him away from last summer's meeting of the society. Incidentally we may remark that this dinner was the first departure, in the society's history, from exclusive devotion to professional deliberations. As a social occasion, a means for bringing the members together outside of the meeting rooms and the hotel lobbies, the event was appreciated.

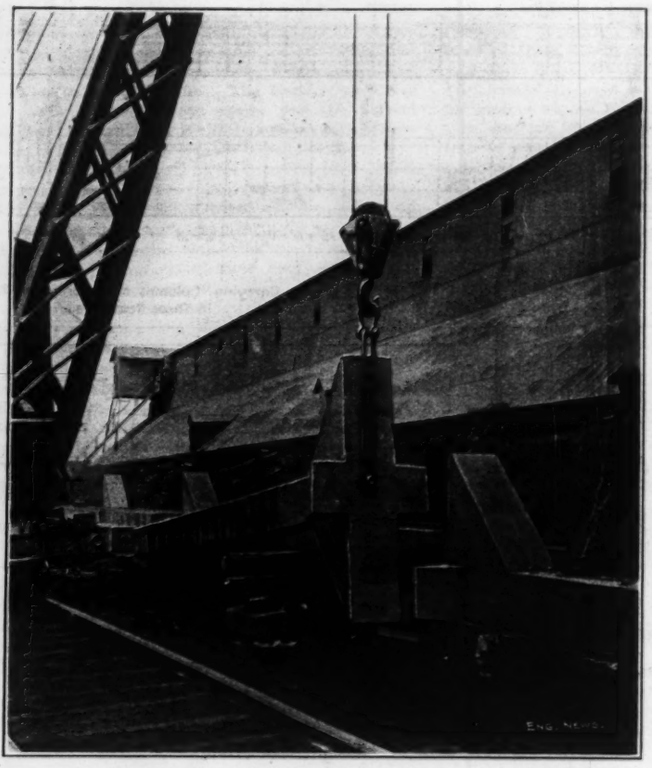


FIG. 7. RAISING A COLUMN FROM CASTING BED FOR TRANSPORTATION TO BUILDING SITE.

The business action of the meeting was restricted to electing two members of the Executive Committee. Mr. W. R. Webster and Mr. W. A. Bostwick were elected. The report of the Executive Committee showed a gain in membership of 90, bringing the total up to 925. The financial affairs of the society seem to have been running on only a close margin, in fact, the past year shows a deficit of about $20, a condition which is expected to be only temporary, however.

Professional Proceedings.

The work of the American Society for Testing Materials is so largely crystallized in the specifications which the society formulates, that we may properly begin our review of the proceedings at this meeting with a summary of the committee reports and the action had upon them. It is easy to single out as foremost the report of Committee A, on Iron and Steel, presenting a specification for steel rails, which with the associated discussion of rail quality and rail failures occupied an entire three-hour session. This report produced definite action; as the recommended specification was passed for ballot. For the contrary reason, the report of Committee C, on Cement, is second in interest; in spite of very animated discussion in favor of revising the cement specification, no action in that direction resulted.

SPECIFICATIONS FOR STEEL RAILS, AND A DISCUSSION OF RAILS AND THEIR SERVICE.

The labors of the society in developing a steel rail specification were initiated five or six years ago, and have been continuous since then. The work has been in the hands of Committee A, on Standard Specifications for Iron and Steel, a

body of 44 members, including railway engineers, test engineers, rolling-mill men and others. It has been very difficult for this body, apparently, to agree within itself on satisfactory specification requirements. Various points of contention, for example: permissible percentage of phosphorus, amount of discard from top of ingot, number and details of drop tests, finishing temperature, etc., led the committee on one or two occasions to seek instructions from the society. Finally, last year a complete specification was presented by the committee. But the society refused to pass this specification to ballot, and, instead, voted to instruct the committee to prepare and report a specification adapted to correct as far as possible the defective quality of rails obtained under existing specifications.

FIG. 9. ROOF SLABS CAST IN PILES, READY FOR ERECTION.

A sheet of paper separates each slab from the one below. Successive tiers are staggered 3 ins. to give a projection for raising the slabs with lifting irons, as shown.

Within the past year matters have taken on a different aspect. A few weeks after the meeting of last summer, the American Society of Civil Engineers also rejected a report made by its steel rail committee. During the severe winter just past, an alarming number of rail fractures has drawn widespread attention to the subject of rail quality, and there have been published numerous decided expressions of opinion from railway men and rail makers, the former condemning, the latter defending, the quality of rails furnished in recent years. There was, therefore, an expectation that Committee A would now report a specification essentially different from its previous ones, and designed to secure rails of higher quality. This expectation was not realized. A specification, sustained in the committee by a vote of 22 against 2, was formulated, which is a reaffirmation of the one offered a year ago, with but two changes, namely: (1) specifying a fixed amount of discard, blank in the specification (the blank to be filled by special agreement between buyer and seller), in place of "a sufficient discard"; (2) specifying a minimum distance between supports in the gagging-press, instead of leaving the details of the cold-straightening undefined. No change is proposed in the number of drop tests, namely, one from every fifth blow of steel. It is specified, as was already done in last year's specification, that the drop tests be taken from the top of the ingot, this requirement applying to the first test as well as to the two additional tests to be made in case of failure of the first test.

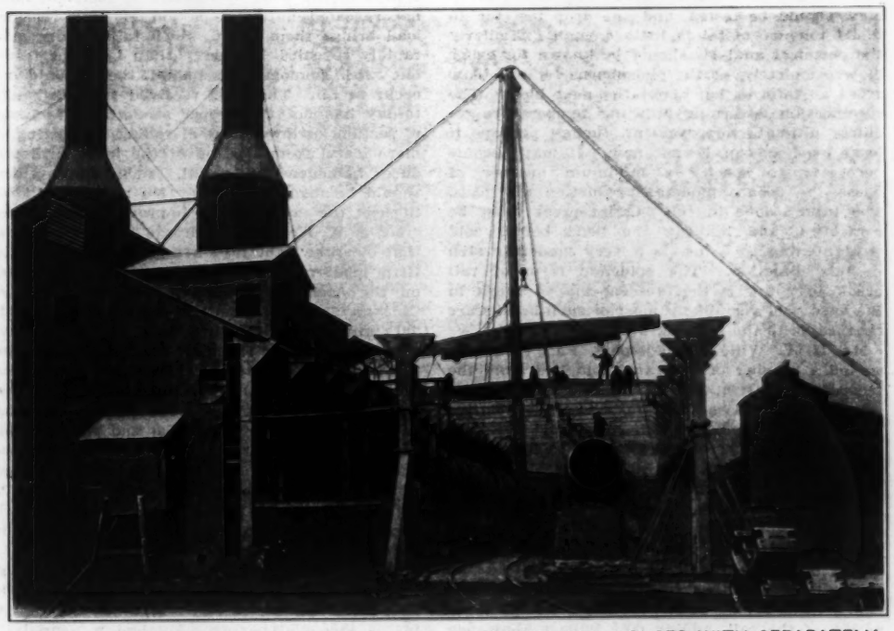


FIG. 10. ERECTION OF TWO REINFORCED CONCRETE KILN HOUSES WITH SEPARATELY MOLDED MEMBERS.

Edison Portland Cement Co., New Village, N. J.

This specification was accepted by the meeting with almost unanimous vote, and passed to letter-ballot of the society at large. It reads as follows:

PROPOSED STANDARD SPECIFICATIONS FOR STEEL RAILS.

(1) (a) The entire process of manufacture and testing shall be in accordance with the best current practice, and special care shall be taken to conform to the following instructions:

(b) Ingots shall be kept in a vertical position in the pit heating furnaces until ready to be rolled or until the metal in the interior has time to solidify.

(c) No bled ingots shall be used.

(d) There shall be sheared from the end of the blooms formed from the top of the ingots not less than x % [the percentage of minimum discard in any case to be subject to agreement and it should be recognized that the higher this percentage the greater will be the cost], and if, from any cause, the steel does not then appear to be solid, the shearing shall continue until it does.

(2) Rails of the various weights per yard specified below shall conform to the following limits in chemical composition.

	50 to 59 lbs. %	60 to 69 lbs. %	70 to 79 lbs. %	80 to 89 lbs. %	90 to 100 lbs. %
Carbon	0.35-0.45	0.38-0.48	0.40-0.50	0.43-0.53	0.45-0.55
Phosphorus, shall not exceed	0.10	0.10	0.10	0.10	0.10
Silicon, shall not exceed	0.20	0.20	0.20	0.20	0.20
Manganese	0.70-1.00	0.70-1.00	0.75-1.05	0.80-1.10	0.80-1.10

(3) One drop test shall be made on a piece of rail not less than 4 ft. and not more than 6 ft. long, selected from every fifth blow of steel. The test shall be taken from the top of the ingot. The rail shall be placed head upwards on the supports, and the various sections shall be subjected to the following impact tests under a free falling weight:

Weight of rail, lbs. per yd.	Height of drop, ft.
45 to and including 55	15
More than 55 to and including 65	16
More than 65 to and including 75	17
More than 75 to and including 85	18
More than 85 to and including 100	19

If any rail break when subject to the drop test, two additional tests, taken from the top of the ingot, will be made of other rails from the same blow of steel, and if either of these latter tests fail, all the rails of the blow which they represent will be rejected, but if both of these additional test pieces meet the requirements, all the rails of the blow which they represent will be accepted.

(4) The number of passes and speed of train shall be so regulated that on leaving the rolls at the final pass the temperature of the rail will not exceed that which requires a shrinkage allowance at the hot-saws, for a 30-ft. rail of 100-lb. section, of $6^{11}/_{16}$ ins., and $^1/_{16}$-in. less for each 5-lb. decrease of section. These allowances to be decreased at the rate of .01-in. for each second of time elapsed between the rail leaving the finishing rolls and being sawn. No artificial means of cooling the rails shall be used between the finishing pass and the hot-saws.

(5) The drop testing machine shall have a tup of 2,000 lbs. weight, the striking face of which shall have a radius of not more than 5 ins., and the test rail shall be placed head upwards on solid supports 3 ft. apart. The anvil block shall weigh at least 20,000 lbs., and the supports shall be part of, or firmly secured to, the anvil. The report of the drop test shall state the atmospheric temperature at the time the test was made.

(6) The manufacturer shall furnish the inspector, daily, with carbon determinations for each blow, and a complete chemical analysis every 24 hrs., representing the average of the other elements contained in the steel, for each day and night turn. These analyses shall be made on drillings taken from a small test ingot.

(7) Unless otherwise specified, the section of rail shall be the American Standard, recommended by the American Society of Civil Engineers, and shall conform, as accurately as possible, to the templet furnished by the railroad company, consistent with paragraph No. 8, relative to specified weight. A variation in height of $^1/_{64}$-in. less, or $^1/_{32}$-in. greater than the specified height, and $^1/_{16}$-in. in width will be permitted.

(8) The weight of the rails will be maintained as nearly as possible, after complying with paragraph No. 7,

to that specified in contract. A variation of one-half of one per cent. for an entire order will be allowed. Rails shall be accepted and paid for according to actual weights.

(9) The standard length of rails shall be 30 ft. Ten per cent. of the entire order will be accepted in shorter lengths, varying by even feet to 24 ft., and all No. 1 rails less than 30 ft. shall be painted green on the end. A variation of ¼-in. in length from that specified will be allowed.

(10) Circular holes for splice bars shall be drilled in accordance with the specifications of the purchaser. The holes shall accurately conform to the drawing and dimensions furnished in every respect, and must be free from burrs.

(11) Straightening—Care must be taken in hot-straightening the rails, and it must result in their being left in such a condition that they shall not vary throughout their entire length more than 5 ins. from a straight line in any direction, when delivered to the cold-straightening presses. Those which vary beyond that amount, or have short kinks, shall be classed as second-quality rails and be so stamped.

The distance between supports of rails in the gagging press shall be not less than 42 ins.

Rails shall be straight in line and surface when finished—the straightening being done while cold—smooth on head, sawed square at ends, variation to be not more than $\frac{1}{32}$-in., and prior to shipment shall have the burr occasioned by the saw cutting removed, and the ends made clean. No. 1 rails shall be free from injurious defects and flaws of all kinds.

(12) The name of the maker, the weight of rail and the month and year of manufacture shall be rolled in raised letters on the side of the web, and the number of blow shall be plainly stamped on each rail where it will not subsequently be covered by the splice bars.

(13) The inspector representing the purchaser shall have free entry to the works of the manufacturer at all times when the contract is being filled, and shall have all reasonable facilities afforded him by the manufacturer to satisfy him that the finished material is furnished in accordance with the terms of these specifications. All tests and inspections shall be made at the place of manufacture prior to shipment.

(14) No. 2 rails will be accepted up to 10% of the whole order. Rails that possess any injurious defects, or which for any other cause are not suitable for first quality or No. 1 rails, shall be considered as No. 2 rails; provided, however, that rails which contain any physical defects which impair their strength shall be rejected. The ends of all No. 2 rails shall be painted white in order to distinguish them.

Before the vote accepting these specifications was taken, however, two hours were spent in general discussion of the rail question. Mr. W. R. Webster (Philadelphia, Pa.), chairman of the committee, opened with a plea for revised sections for heavy rails (over 80 lbs. per yd.), a plea which he had advanced as early as six years ago. He says:

> If a rail with the same width of head as the present Am. Soc. C. E. 100-lb. rail is required, the head will have to be made thicker and the radius under the head larger in order to prevent the sides of the head from shearing or breaking off as at present, and more metal put in the web and flange in order to carry the heat and thus allow the head to be finished at the proper low temperature. This would mean a rail of 120 to 125 lbs. per yd. I believe we are coming to heavier rails before we get rid of our present troubles.

On the much-mooted question of Bessemer vs. open-hearth steel for rails he makes the following comment:

> Open-hearth steel rails of the present weight and section rolled under the present conditions of manufacture cannot be relied on to overcome all troubles. Most of the basic open-hearth steel manufactured in this country is much lower in carbon than required for rail steel, and it is therefore very much easier to control the uniformity of such steel. The common practice of Bessemer steel rail mills is to allow ten points leeway in carbon, and some of the basic open-hearth mills claim to work within these limits, but even as high as eighteen points leeway has been asked. It is easier to work within narrow limits of carbon in the acid open-hearth steel process than in the basic. What is wanted is a steel as nearly uniform in carbon and other chemical elements as possible without inflicting too great hardship on the manufacture.

Mr. Webster then suggested that as an experiment 1,000 tons each of Bessemer and basic open-hearth steel rails be rolled to such a section as would permit finishing at low temperature without injuring the metal in the flange, in order to determine the comparative value of the two steels in rail service.

Mr. Benjamin Talbot (Middlesbrough, England) in a written discussion gave the results of some drop tests on heavy (apparently 100-lb.) T-rails recently made by the Talbot continuous open-hearth process. A specimen is: C 0.47%, Si 0.037, S 0.038, P 0.04, Mn 0.87%, which rail on 42-in. centers stood seven blows of a 1-ton weight falling 30 ft., and did not break but twisted at the seventh blow; in these tests alternate blows were in reversed position, practically straightening out the rail, and the final deflection was $3^{3}/_{16}$ ins. This steel was made from phosphoric Cleveland pig-iron. Mr. Talbot also advocated designing T-rail sections with more metal in flange and web; ideally, he says, the base and head should be of equal area, but any approximation toward this would be of value.

To show that almost equally good performance has been exhibited by Bessemer steel, Mr. W. R. Webster cited tests made on Bessemer rails of 0.35 to 0.45% carbon, with phosphorus below 0.08%. These rails were required to bend to 110° under the drop hammer. They were bent to this angle by two blows of a 2,240-lb. weight falling 25 ft., the supports being 4 ft. apart, and were then given several additional blows, without breaking.

Mr. R. W. Hunt (Chicago, Ill.) agreed with the claim that our present standard sections for heavy rails should be revised. The committee of the American Society of Civil Engineers which drew up these sections, in the early '90's, based its work on an 80-lb. section, which size was then just beginning to come into use (New York Central, Delaware & Hudson, and Michigan Central, had adopted the 80-lb. rail, though there was some 90-lb. rail on the Philadelphia & Reading). The sizes above these, arithmetical enlargements of the section worked out for this weight, magnify the weaknesses of this section. Change in sections, however, is only part of the improvement necessary. Good metal must be produced in the rail, chiefly by taking more time in rolling. In a modern rail mill many ingots in the very first pass develop large cracks across the surface, due to the great reduction in this pass; these cracks close up or draw out in the subsequent passes but do not weld up, and they remain as flaws in the finished rail. He believes that many rail breakages can be traced to this defect. The rolling should be conducted with less reduction per pass, more passes, and at a lower temperature. Coming to the specifications presented by Committee A, Mr. Hunt objected to specifying a drop test for every fifth blow; every blow should be tested, and one drop test for 15 to 20 tons of metal is little enough. Similarly the chemical analysis should be known for every blow completely, as the phosphorus for one blow gives no information about the next blow. The specification governing finishing temperature requires ultimate improvement, though perhaps it is as good as can be got now. It may become necessary to specify a minimum number of passes, to secure moderate reduction per pass. The injury done in the gagging-press must be controlled, and limiting the bend before cold straightening to 5 ins. is a very moderate step in this direction. The epidemic form of rail break just now is the crescent-shaped break in the base, and very likely most of such breaks are chargeable to the gagging-press.

Mr. H. V. Wille (Philadelphia, Pa.) then presented a number of diagrams compiled from the records of construction of the Baldwin Locomotive Works. These diagrams show the relative driving-wheel loads, average axle-load, and total weight, for the 22 yrs. since 1885, based on the figures for that year, separately for various types of engines. The increase generally has been more or less uniform, reaching 85 to 95% and averaging about 90%. However, some calculations by Mr. J. C. Bland (Pittsburg, Pa.), referred to by Mr. C. B. Dudley, showed that the strength of rails has increased faster than the loads; these calculations were based on the beam action of the rail, adding 60% impact allowance to the static load, an allowance which Prof. Mansfield Merriman and others criticized as insufficient. Mr. P. H. Dudley (New York), giving the results of actual stress measurements on rails, stated that 15 or 20 yrs. ago the extreme fiber stress under passenger trains was 25,000 to 30,000 lbs., and the stress in the modern 100-lb. rail under modern passenger traffic is not much less.

A further contribution of Mr. P. H. Dudley to the discussion was an extended paper entitled "Mechanical Experiences with Limber and Stiff Rail Sections." This paper divided the past improvement of rails into three parts: the substitution of T-shaped rails for strap rails after the insufficient stiffness of the latter had checked progress in load-concentration; the replacement of iron by steel, following the failure of iron from excessive wear and destruction by high contact pressure; and the gradual increase in section to provide greater stiffness and beam strength, to resist the stresses set up in the depression of rails and roadbed under the train. This succession of changes has now brought us to the point where the limiting properties of the metal, rather than insufficient bending strength, are again giving trouble. The indications are that much of this trouble is due to the methods used in manufacture. The split head that occurs so often is an indication of defect in the metal, not, however, a defect so pronounced as a pipe. The appearance suggesting a cavity or pipe, found in most split heads, Mr. Dudley regards as being produced in service and not existing originally: local crushing occurs in the center or near the top of the head, at a cinder streak or a point of segregation; this gives rise to a double wedge of metal at the top of the rail, which, flowing and spreading under succeeding wheels, gradually splits the head. One strong contributing factor in the predisposing conditions is too rapid casting of the ingots, or insufficient time between recarburizing and teeming.

Mr. Charles S. Churchill (Roanoke, Va.) said that rail failures on the Norfolk & Western do not support Mr. Webster's contentions. The step from light to heavy rails is not made all at once, but both exist simultaneously in the track and their service can be compared. The Norfolk & Western has been putting in 85-lb. rail since 1894, but still has many lighter rails in the track. If the old rail was really too light for the traffic of to-day, its survivors should be breaking frequently in the track; but this is not the case, the heavier sections breaking more often than the 67-lb. rail. He agrees with Mr. P. H. Dudley's explanation of the mechanism of failure in large rails, and would charge most breaks in the body and flange to incipient flaws not revealed until the action of high repeated load brings them forth. Such failures are more rapidly revealed by heavy than by light traffic, but with homogeneous metal they should not occur at all. The steel received from rail mills to-day has not the proper strength. If change of section, or lower heat of rolling, or cutting off more metal from the top of the ingot, will produce homogeneous metal, such improvement should be made promptly. No railway will fail to meet the exact cost of improved manufacture.

Mr. J. W. Kendrick (Chicago, Ill.) also reported that old-time light rails are giving better service than modern heavy sections. Some 75-lb. rail on the Atchison, Topeka & Santa Fe between Chicago and Kansas City was re-rolled in the '90's and laid in the lines west of Albuquerque, where it has had traffic of the heaviest engines in the world excepting the new large Mallet locomotives; here it has given better service than the later 85-lb. rail. He believes that the effect of re-rolling is very valuable, and that, in rail-making, at some stage of the rolling the rail should be reheated and re-rolled. If the makers of rails do not take up the matter of improving rail quality, legislation on the subject is to be apprehended, and this will be most damaging both to railways and rail-makers.

Mr. E. F. Kenney (Philadelphia, Pa.), though a member of Committee A, expressed his belief that 3 ins. camber of rail before cold-straightening is ample allowance. He had measured the camber of every rail rolled in a certain mill in one day, and found that all came within the limit of 3 ins. camber; it is likely therefore that with care this requirement could always be met. He also spoke against decreasing the size of the rail head in any revision of section. His opinion on the question of quality was put very distinctly: that metal is being put into rails to-day that is considered absolutely unfit for any other service.

Mr. W. A. Bostwick (Pittsburg, Pa.), speaking

on the other side of the question, remarked briefly that the quality of steel represented in Talbot's English drop tests is much softer than is permissible under American conditions. Mr. P. E. Carhart (Chicago, Ill.) said, in defense of modern rail manufacture, that the increased speed and output which has been criticized is due solely to the elimination of waste time, as in changing rolls, etc. The same size of rolls, the same speed and the same power are used to-day as were used in 1890. Continuous working, not allowing the rails to get cold, is in fact helpful to good results. In investigating a large number of rail breaks he has always found that it could be charged to the impact effect of badly unbalanced drivers. In the case of one road, whose motive power was very well maintained, a number of rail fractures led to careful investigation which disclosed a large flat spot on the driver of a heavy engine, the spot being about 30 ins. long and $\frac{5}{8}$-in. deep at the middle. When this wheel was turned true, the rail fractures stopped. A flat spot can deliver a very heavy blow upon a rail, well adapted to produce the moon-shaped break in the base, now so common. However, Mr. R. W. Hunt (Chicago, Ill.) cited the case of a division of the Erie Ry., where the west-bound track has 75-lb. rail while the east-bound has 85-lb. rail, both being traversed by the same engines. On this division the fractures are on the east-bound track, and they are all moon-shaped breaks. They are not spaced to match the wheel circumference, but often there will be three within 6 ft. of each other.

Prof. Mansfield Merriman (New York City) suggested that the impact in rails requires a much higher allowance than 60%, and that the stresses occurring are considerably higher than have been calculated. He laid special emphasis on the stresses at the splice, but others remarked that the trouble from breaks does not occur at the joints. Mr. G. E. Thackray (Johnstown, Pa.) took the same position that rail stresses are very high, 40,000 to 50,000 lbs. per sq. in. being shown in stremmatograph tests. On the question of the apparent greater resistance of old light rails as compared with modern heavier rails, he pointed out that the former are the product of automatic selection, which left only the more resistant individual rails, now compared with the unselected new rails.

Mr. P. H. Dudley suggested that the friction of splice-bars is sufficient to allow very high contraction stresses to be set up in cold weather. The winter of 1907 was particularly severe in the matter of long-continued cold waves; 1906 was a lighter winter, while 1905 again was severe. This comparison agrees with the record of fractures on New York State railways for the three winters (see Eng. News of May 2, 1907, p. 493).

Mr. M. H. Wickhorst (Aurora, Ill.) spoke of a case on the Burlington, where on a 3-mile piece of track some 50 rail fractures occurred in a short period last winter. There were some breaks clear across the rail in this number, but most of them were crescent-shaped breaks in the lower flange. Most of them occurred on the north (left-hand with regard to fastest traffic) rail, and on the inside flange. In this track some of the original oak ties had been replaced by soft-wood ties with tie-plates, and a large proportion of the breaks came just over such tie-plates. Engines have a tendency to nose toward the left at the moment when they exert the greatest pressure on the left side, and this may have acted, by the wheel fillet climbing the rail, to put a concentrated load on the inner side of the rail base. Eight of these fractures were studied, and etchings at the fractured section made; all were sound, except one that showed porosity, but there was no pipe. The chemical analyses showed nearly normal, and tensile tests gave no clue, even after heating and forging down. He attributes the breakage to detail fracture, to defects not originally there but produced by the service. A stronger rail-base is suggested. Mr. J. P. Snow (Boston, Mass.) also studied a number of crescent-shaped breaks, with the same results, except that he always found evidence of a longitudinal seam or crack in the base of the rail, forming the rear side of the resulting break. These seams showed sharp edges, and at times partial rust discoloration. Polished sections under the microscope showed a large number of minute vertical cracks. Mr. Wickhorst expressed the belief that this condition is the result of traffic, producing detail fracture. Mr. Snow, however, said that if a rail which exhibits such failure he turned head down, a laborer with a sledge, striking the sides of the base, can break out a crescent at nearly every blow, while with a normal rail this is quite impossible.

Mr. James E. Howard (Watertown, Mass.) stated that the Ordnance Department will during the coming year devote attention to the subject of ingot structure, using the testing plant at Watertown Arsenal. It is possible that these studies may afford assistance in the matter of steel rails. It seems certain that the examination of steel quality should begin with the ingot; if the ingot has defective structural continuity the fault will not be wholly obliterated in the subsequent processes. Illustrating such discontinuity, in a fluid-compressed ingot there was found an orientation of defects which resulted in a tensile strength 50 or 60% lower transverse to this orientation than parallel to it.

The preceding represents the general course of the rail discussion sufficiently for present purposes. Summarized, it hardly brings any clear trend of opinion on either side of the question of bad rail steel. Possibly the failure of rail makers to take prominent part in the discussion accounts for some of this. At any rate, outside of the proposal to revise the sections, almost no concrete suggestion appeared toward a specification for better rails.

As already noted, the final vote on the question of accepting the specifications was favorable, although last year, with an almost identical specification, the opposite sentiment appeared. But the favorable vote was not taken without some opposition. Mr. R. W. Hunt moved that the subject be referred back to the committee, and his motion was seconded by more than one voice. On representations from Mr. Webster, however, he was led to withdraw his motion. Mr. C. B. Dudley, Mr. Edgar Marburg, Mr. E. F. Kenney and others supported the acceptance of the specification, principally with the argument that it is important that the society should put on record, as a basis for subsequent improvement, what its committee has found to be the best specification obtainable to-day on which all parties to the matter are willing to agree. The vote to pass the specification to letter-ballot then carried, with substantial unanimity.

STANDARD SPECIFICATIONS FOR CEMENT.

The present standard specifications for cement as adopted by letter-ballot by the American Society for Testing Materials on Nov. 14, 1904, is in two parts. The first part, consisting of a general definition of cement and of properties which it should possess, is the work of a special committee of this society on Standard Specifications for Cement; the second part, which sets forth in detail the manner of testing by which these properties may be discovered, is taken from the methods recommended by the special committee on Uniform Tests of Cement of the American Society of Civil Engineers. When adopted in 1904 these specifications were the result of some years of painstaking work on the part of a large committee made up of both consumers and producers of cement. There was at that time some opposition to its adoption on the part of certain members who thought that there were still many points in it which did not represent the highest standards and that rather than adopt a specification which would have to be changed every year it would be better to wait until a perfect specification could be framed. It was, however, the opinion of the majority that the proposed set of standards was correct in all but a few minor details, and that the progress of cement manufacture and testing would be better furthered by the promulgation of a nearly correct system of specification than by the absence of any standard fixed by a competent body. The admittedly incomplete and partially incorrect specifications were therefore adopted with the assurance to the objecting members that they were merely to be viewed as a basis for a start, the first step toward the ideal specification, and that as soon as it was deemed desirable they would be amended or added to.

In the 1905 and 1906 meetings this committee reported that certain changes had been referred to and carefully considered, but after due deliberation the committee had decided to allow the specifications to stand as adopted and to report progress. At this year's meeting practically the same report was made which caused considerable opposition and discussion. Mr. Charles F. McKenna (New York City) said that his principal opposition to the adoption of the specifications in 1904 was met by an assurance that ample opportunity would be given at the next meetings to change the specifications. In each of the three meetings since that time the committee has reported progress and the report had been accepted with no opportunity for members to discuss on the floor and put on record their opposition to many provisions in the standards which were recognized to-day as being inoperative. Mr. L. W. Walters (Erie R. R.) agreed with Mr. McKenna. A specification which was behind the times in many of its important features was as bad as no specification, and it could not be too strongly impressed upon the committee that the delay in making the promised changes in the specifications should not be put off for any further length of time. No one of the gentlemen opposing the present standards made specific reference to any defects in them, although in a later paper by Dr. R. K. Meade on the "Specific Gravity of Portland Cement" the entire present provisions regarding specific gravity were said to be useless, or at least misleading. Mr. G. S. Webster (Philadelphia) and Mr. R. L. Humphrey (St. Louis), Vice-Chairman and Secretary, respectively, spoke in defense of the action of the committee. Through much correspondence during the past year and one meeting held the first part of June, they had decided that the time was not yet ripe for any changes. They reiterated their statements of 1904 that although the specifications were not perfect they represented very good practice and had served for the last three years in a very satisfactory manner. All proposed changes had been considered from all sides, and while recognizing the value of many of the recommendations, they thought the best purposes of the committee would be served by postponing action for another year. This action of the committee was upheld by a majority vote of the meeting.

SPECIFICATIONS FOR GRADING STRUCTURAL TIMBER.

Committee Q submitted, as its report, a set of definitions and specifications covering an important part of the timber field. The material with which this committee is concerned is commercial lumber other than boards, and therefore designated as "structural timber." This includes such articles as bridge and trestle timbers, car sills and framing, timber used in the framework of wooden buildings, and the like. At the meeting of 1906, the committee proposed a list of Standard Defects and a list of Standard Names for Structural Timbers. These have been slightly modified since then, and as revised were again presented in 1907. With these was presented a specification for Bridge and Trestle Timbers, and two tentative specifications for Car Sills and Framing of Freight Cars, and for Timber for Framing Buildings. The committee asked that the first three items be accepted and passed to letter-ballot, while the two last-named specifications be merely received. A motion in this sense carried.

FIREPROOFING MATERIALS COMMITTEE.

At last year's convention this committee submitted a tabulated account of some 80 fire tests made in this country and abroad, together with a Proposed Standard Test for Fireproof Floor Construction. As the report was rather hurriedly passed over at that time the entire report this year consisted of a reference to the previously printed tables and a reprint of the Standard Test. Several of the members objected to certain portions of this test. The term "working

load of 150 lbs. per sq. ft.," for which the construction is to be tested was changed to "superimposed live load of 150 lbs. per sq. ft." Mr. R. H. Humphrey doubted the advisability of specifying a wood fire with which to raise the temperature to the desired 1,700° F., and stated that as long as the proper heat was produced it made small difference how it was arrived at. In the St. Louis laboratory of the U. S. Geological Survey gas jets were used with great success. Prof. I. H. Woolson, chairman of the committee, claimed that the wood gave conditions most closely approximating an actual conflagration not only as concerns the distribution of the heat, but also as regards the cold air drafts which enter on firing and which resemble the drafts in a house fire resulting from broken windows and doors. Mr. John G. Brown (Philadelphia) rather doubted the necessity for so long a test as the four hours specified, but after considerable discussion with Prof. Woolson finally agreed that it was no longer than the maximum duration of a conflagration and that such tests should have the safety factor of approximating the worst conditions. Mr. Sanford E. Thompson proposed that two classes of tests should be made, one for two hours and one for four hours, so if a material could not pass the four hour test it might get a two hour classification. Prof. Woolson agreed that if a proprietor was willing to admit that his material was not good enough to pass the four hour test he would be very glad to give him the lower grade, but that he doubted if it would be of much commercial value to him. With the minor change of words noted above the report was referred to letter-ballot.

COMMITTEE ON STAYBOLT IRON.

A complete specification for iron for staybolts from ⅞-in. to 1⅛ ins. diameter was submitted by Mr. H. V. Wiple (Philadelphia, Pa.) for committee M. The specification fixes the method of piling the bloom from which the iron is to be rolled or hammered, and further provides physical tests (but no chemical tests) of the finished material, including tensile, cold bending, threading, and vibratory test. The committee stated that these requirements have been used by one of the largest consumers of staybolt iron for two years and that several manufacturers have adopted the method of piling. The acceptance of the specifications was therefore moved. But Mr. J. A. Kinkead (Schenectady, N. Y.) objected to specifying both the method of piling and a vibratory test, on the ground that if the latter test is of value any iron should be passed irrespective of method of piling; he believes, however, that the vibratory test does not give reasonably consistent result, and finds that even with a single machine variations of 25% in ultimate number of vibrations occur. Mr. M. H. Wickhorst (Aurora, Ill.) and Mr. E. D. Nelson (Altoona, Pa.) agreed in part with this criticism. Mr. Nelson reported that iron made by another method of piling than the one specified has shown equally good results, both in test and in service. After this discussion the specification was by vote referred back to the committee for reconsideration, with instructions to report the several views of the committee members on points of difference.

COMMITTEE ON UNIFORM SPEED IN TENSION TESTS.

A very extensive study of wrought-iron in tension tests was reported by Committee O, headed by Mr. Paul Kreuzpointner (Altoona, Pa.), supplementing the report of last year on a similar study of steel. The conclusions on steel were that a maximum speed of 3 ins. per min. for steel of forging grade (2-in. test piece) and 6 ins. per min. for steel of boiler grade (8-in. test piece) was recommended in determining ultimate strength; while it was suggested that the elastic limit should be taken with the dividers at a low speed, to insure approximate reliability and uniformity of results. For studying iron in the same way, no less than 1,014 tension tests were made (250 of staybolt iron and 764 of common iron). As a result it is recommended that for testing wrought-iron any speed up to and including 6 ins. per min. gives safe results for commercial purposes. No attempt was made to take the elastic limit, and the recommendation does not refer to this measurement.

COMMITTEE ON STANDARD METHODS OF TESTING.

A somewhat related subject was reported on by Committee K, through Prof. G. Lanza (Boston, Mass.). This is an inquiry to learn the methods of testing practiced by different laboratories here and abroad, and if possible to formulate therefrom a set of standard methods. Nearly 300 laboratories were addressed to this end, but only a small proportion has yet replied. The replies are being collated and studied by subcommittees on individual tests: Mr. M. Merriman on compression tests, Mr. R. Moldenke on transverse tests, Prof. W. K. Hatt on impact tests, etc. No results of value can yet be reported.

REPORT OF COMMITTEE ON REINFORCED CONCRETE.

The Committee on Reinforced Concrete during the past year has followed its previous practice of cooperation with the Joint Committee on Concrete and Reinforced Concrete, but has not taken the initiative in any test or investigations. The Joint Committee in its study of the subject is keeping in touch with the work of the various technological and college laboratories and of the Structural Materials branch of the U. S. Geological Survey located at St. Louis. Through these various laboratories it is collecting all of the great amount of experimental data that is being constantly accumulated and is digesting the results so that in a short time, it is hoped by next year's meeting, a valuable comprehensive report on reinforced concrete will be presented. The committee reported progress and was continued until next year.

COMMITTEE ON WATERPROOFING MATERIALS.

This committee was last year divided into two sections: (A) which had charge of all materials added to cement when mixed in concrete or used neat for the purpose of imparting thereto a waterproof condition and (B) having charge of all materials of a bituminous nature, superficially applied directly or through any medium to the surface of structures for the purpose of waterproofing. The latter committee has accomplished nothing on which to base any report even of progress and asks to be continued; the entire report is therefore from Section A. This section had the aid of three well equipped laboratories, but as the reports were not submitted until very late in the spring no report other than that of progress could be made. The only conclusions arrived at by the subcommittee follow:

Data so far obtained indicate that the majority of waterproofing compounds examined under the jurisdiction of Subcommittee "A" are no more effective than untreated properly proportioned mixes which certainly can be made absolutely waterproof by the use of proper materials and well proportioned mixes. It is entirely possible that some compounds do effect an improvement in badly proportioned mortars and concrete made up of inferior materials. Undoubtedly some surface washes are effective.

COMMITTEE ON COKE.

Committee J, on Standard Specifications for Coke, was not ready to present a report, but expects to submit a report to the secretary in the course of some months.

COMMITTEE ON TESTS FOR LUBRICANTS.

The committee reported progress.

COMMITTEE ON STEEL SPRINGS.

A tentative specification for spring steel and finished leaf springs was submitted by Committee T, Mr. J. A. Kinkead (Schenectady, N. Y.), chairman. The steel is to contain 0.90 to 1.10% carbon, not over 0.50% manganese, not over 0.05% of sulphur or phosphorus. The bands of leaf springs are to be of wrought-iron. The chief test requirements are for height: this to be not less than specified, nor more than ⅜-in. greater, for specified load, on the increasing curve, while on the decreasing curve from 50% overload the height at specified load must not be greater than, nor more than ⅜-in. less than, the specified height; in neither case may any set be shown on release.

COMMITTEE ON PRESERVATIVE COATINGS.

Committee E, on Preservative Coatings for Iron and Steel, has an exposure test on an unprecedented scale now in progress. The Pennsylvania R. R. has loaned for this test the new double-track deck bridge over the Susquehanna River at Havre de Grace, Md. To this bridge 19 different paints have been applied by the committee, each to a separate panel. Not only were the members of the bridge thus painted, by a method carefully kept uniform, but at each panel nine plates, 24 × 36 ins., were painted and exposed, three different spreading rates being used, three plates to each, the paints on the plates being the same as used on the corresponding panel of the bridge. The paints in the test include red lead, graphite, carbon black, lampblack, iron oxide, zinc oxide, asphaltum and other paints. Inspection of the bridge is to be made every six months or oftener. Methods of inspection have been formulated.

Technical Papers.

As already remarked, there were some forty technical papers presented and discussed at the meeting. Some of these were related or auxiliary to reports of committees, but most of them were independent. All of them contain interesting matter, but it will be possible here to summarize only those having special claim to prominence, as reporting new observations or other advances. For the sake of completeness mention is made by title of all papers, however, as far as practicable.

To begin with, Messrs. P. H. Knight and C. E. Skinner (Pittsburg, Pa.) presented a paper entitled "The Raw Material Supply," which stated clearly some of the difficulties met in providing the raw materials for a large manufacturing plant, and suitable methods for handling these difficulties.

The subject of providing one of the most important raw materials, coal, was separately discussed in a symposium of three papers: "The Purchase of Coal under Specification," by Mr. J. E. Woodwell; "The Recent Testing of Coals used by the Federal Government in its Public Buildings in Washington," by Messrs. J. A. Holmes and D. T. Randall; and "Methods of Testing Coal," by Mr. S. S. Voorhees (Washington, D. C.). These papers explain the reasons and methods of the purchase of coal under specification, practised by several of the Government departments (as well as by a number of very large private consumers). The paper of Mr. Woodwell discussed various possible and actual ways of specifying quality of coal in a purchase contract, and described a broad coal-purchase form which has been worked out recently by the government authorities, providing an adaptable basis for the purchase of coal for every purpose, under any local conditions. In this form the payment is in direct proportion to the heating value of the coal as received, with special deduction for ash exceeding the amount specified. The paper of Messrs. Holmes and Randall described work done by the Fuel-Testing Division of the U. S. Geological Survey in testing coal furnished to a number of government buildings in Washington, D. C., and gives tables of the results of the tests. The paper of Mr. Voorhees reports the methods and results of tests made by the Treasury Department during the last year of coal delivered to 22 public buildings in 16 different cities.

Mr. H. M. Wilson (Washington, D. C.) stated, in connection with these papers, that most of the fuel-testing plant of the Geological Survey has been transferred to Norfolk, Va., except that the coking plant has been sent to Denver. At Norfolk it is planned to make extensive tests of the important grades of coal reaching this port, and also of lignites from Texas and peat from Maine, the Dismal Swamp and Florida. It is planned also to study the influence of size of coal on actual efficiency of combustion under boilers. Experiments with denatured alcohol will also be made. Further discussion revealed that it is not easy in all cases to get dealers to furnish coal under a specification. In some cities it is almost or quite impossible to buy anthracite

a specification, while in other cities there is more difficulty with bituminous coal men. This situation is not rare in the field of specifying and testing materials, as Mr. C. B. Dudley and Mr. R. W. Lesley pointed out. The cement situation a number of years ago was just the same, but once started the practice of buying and selling under specification spread until it is universal to-day. A sentiment of Mr. Dudley, that "a good specification honestly enforced is a protection to the best men in the trade," applies directly to the difficulty.

A paper by Mr. Robert Job (Philadelphia, Pa.) on "Iron Castings: Some Causes of Failure in Service," related an instance where unsatisfactory conditions in the foundry, due to buying by brand and mixing by guess, were corrected with success by purchasing iron and coke on test, and mixing the iron according to analysis. A reference to iron oxide as an impurity led Mr. R. Moldenke to remark that the question of oxide is becoming more important because of the large and extending use of steel scrap in the cupola charge. It has been found that, as in steel making, ferro-manganese is valuable to clean the iron in special cases, and he suggested therefore that it is hardly reasonable to attempt to limit the manganese in buying pig.

In a paper "The Effect of Moisture on the Strength and Stiffness of Wood," by Mr. H. D. Tiemann (New Haven, Conn.), were outlined in condensed form the results obtained at the Yale timber-testing station of the Forest Service, as given in a bulletin issued under the same title by the Service. These results include: More accurate curves of the decrease of strength with increase of moisture, the recognition of a "fiber-saturation point," beyond which increase of moisture has no influence, the effect of various methods of drying, and the effect of special heat treatments in rendering wood less hygroscopic. The last-stated observation is not contained in the bulletin named, but will be published shortly.

Fifteen selected tests of brick piers, from the Watertown Arsenal records, were reported by Mr. J. E. Howard (Watertown, Mass.). These tests were made on piers about 12 × 12 ins., 8 ft. high, and the selected ones showed strengths over 3,000 lbs. per sq. in. On the modulus of elasticity the author observes:

> During the early stages of loading, piers which are made of hard-burnt brick laid in cement mortar show moduli of elasticity in the vicinity of 3,000,000 to 4,000,000 lbs. per sq. in. As the loads advance the value of the modulus commonly drops somewhat, an effect attributed to the action of the mortar. Permanent sets are of small magnitude in piers of this class. If lime mortar is used large sets are developed and lower moduli of elasticity prevail. * * * The modulus of elasticity of strong mortar or neat cement is less than that of hard-burnt brick, hence it follows that the best cushioning effect at the joint is reached when the mortar is of even thickness.

CONCRETE AND REINFORCED CONCRETE.

Mr. Howard read a brief paper entitled "Some Additional Notes on Tests of Concrete Columns." A hooped column of 1:2:2, spirally reinforced, stood over 7,700 lbs. per sq. in., and a neat cement column stood 7,000 lbs. per sq. in., without failure. These two columns are exhibited at the Jamestown Exposition, in the Watertown Arsenal Testing Laboratory's exhibit, together with another 1:2:2 column on which a load of 1,000 lbs. per sq. in. is being maintained by means of steel side rods.

An important paper on "Tests of Concrete Columns" was read by Prof. A. N. Talbot (Urbana, Ill.). Unfortunately, as this paper has not yet been reduced to writing we are unable to give more than a suggestion of its contents. It reported extensive tests made at the University of Illinois on hooped concrete columns, and analyzed their results. Tests of plain columns, and columns with longitudinal reinforcement, had previously been made. The latter showed that longitudinal reinforcement enables the columns to take slightly greater compressive deformation than a plain column, but substantially the strength is only that of the concrete plus the steel equivalent. In the tests of plain columns Poisson's ratio was found (by measurements of the bulging) to vary from 1/10 to about 1/4. The tests of hooped columns showed a great increase of load and deformation. However, the stress-strain curve is practically identical with that of a plain concrete column, up to about the point of rupture of the latter; from this point on, the curve becomes almost a straight line, whose prolongation would intersect the line of zero deformation near the point of ultimate load of a plain column; finally, the curve bends to a direction parallel to the deformation axis and failure occurs. The important indication is that the hooping apparently does not enter into action until the load is reached where a plain concrete column would fail. The permanent set, of course, is of much interest in this connection, but this was not covered in the abstract of the paper as presented by Prof. Talbot at the meeting, except in the statement that the set reaches very large amounts.

Mr. Robert A. Cummings (Pittsburg, Pa.) described how he had subjected wooden and reinforced-concrete telegraph poles to bending test. Mr. Cummings made some reinforced-concrete poles for the Pennsylvania R. R., the design being based, with a safety factor of three, on conditions corresponding to a maximum side pull of 1,000 lbs. at the top. To test these against wooden poles, a simple rig was put up, and poles of both kinds tested to fracture, showing that the concrete poles resisted something over 3,000 lbs., while the wooden poles broke at a load some 500 lbs. lower. For this test the poles were fixed vertically in a concrete base cast in the ground; a boom projecting upward at 45° from one end of this base, carried at its end a sheave, over which led a rope from the top of the pole horizontally to the sheave and thence downward to a 5-ton differential-block tackle. The lower end of the tackle was fastened to the short end of a 1:5 lever, whose longer end rested on a platform scale. The fulcrum of the lever was a rocker-bearing on the lower side of the cap of a low bent weighted with 10,000 lbs. of rails. The weight of the tackle was counterbalanced by a counterweight rope passing over a second sheave in the head of the boom, to relieve the test pole from initial load.

In continuation of some experiments made last year (Eng. News, v. 56, p. 658) Mr. T. L. Condron (Chicago, Ill.) reported on additional "Tests upon Bond between Steel and Concrete." The first series reported last year was made upon specimens which had been hauled to the laboratory before they had completely set and, on account of this, displayed rather erratic results. The present series was made and tested in the same laboratory and was much more consistent. In addition to the previous tests upon specimens allowed to age in open air, a portion of the specimens were immersed in water until the day before they were tested. The numerical results of the experiments are too lengthy to reproduce here; however, the following conclusions are of interest:

> In view of the wide range in the value of the strength of bond between plain bars and concrete as reported by different observers, which range is from 83 lbs. to 854 lbs. per sq. in. of embedded surface, depending upon the smoothness of the bars, character of the concrete, and length of embedment, it seems impossible to formulate any rule for determining the value of bond or adhesion of plain bars in concrete.
>
> It is also evident that while twisting of square steel bars does increase the strength of bond, this increase depends upon the degree of twisting the bars receive. In commercially twisted bars there is a great variation in the amount of twisting done and it is not unusual to see twisted bars of the same size delivered on work, some of which are twisted two to four times as much as others.
>
> With reference to special shaped bars, such as corrugated and Diamond bars, since these bars are delivered as they come from the rolls they are of necessity quite uniform as to surface. There would seem to be a marked advantage in having the corrugations or ribs on these bars placed at right angles to the direction of the stresses as in the corrugated bars, rather than at an oblique angle as in the Diamond bar. It is evident that either type of bar can be depended upon to develop the elastic limit of the steel without appreciable slip when placed in good concrete with a moderate length of embedment.
>
> For corrugated bars or bars having equal bond value, an embedment equal in length to 30 times the diameter or length of side of bar will, in good concrete, develop the elastic limit of the steel. If the concrete is to be under water or constantly wet, then for corrugated bars the embedment should preferably be 40 times the diameter or length of side of the bar.
>
> The importance of using bars with a mechanical bond in reinforced concrete is even greater for work that is to be under water or constantly wet, than where the structure is exposed to air on all sides. So far we have few data regarding the effect of repeated stresses, reversal of stresses, and shocks upon the bond between concrete and steel in reinforced concrete structures, but such information as we have indicates that there is a progressive breaking of the adhesion between steel bars and concrete under these conditions, and that therefore a mechanical bond between the steel and concrete is of great importance as a means of insuring against progressive failures in reinforced concrete.

A paper by Prof. W. K. Hatt (Lafayette, Ind.) entitled "Effect of Time Element in Loading Reinforced-Concrete Beams" described experiments conducted under four conditions of loading: i. e., (1) the usual process, in which a beam is loaded with continuously increasing loads until failure; (2) repetitive loads of different intensities applied a large number of times; (3) constant loads applied for long periods of time; and (4) impact tests. An increased deflection of about twice that under process (1) was noted under constant loading, and the effect of repetitive loadings in increasing the deformation was commented upon. Under process (1) a load causing 3,000 lbs. fiber stress in the steel was accompanied by 0.03-in. deflection, while 700 applications of the load on a similar beam caused a deflection of 1.75 ins. There seems to be a plasticity of concrete that results in constantly increased deformation under repetitive loads. In those beams which failed finally because of the yielding of the steel, this process of repetition did not weaken the concrete. There was no evidence of fatigue, and after some 2,500 repetitions of loads causing stresses from 3,000 to 29,000 lbs. per sq. in. in the steel, the maximum load on the beams so loaded was not diminished as compared with beams loaded under process (1). The load at first pronounced crack was, however, diminished. The permanent deformation was more largely in the concrete than in the steel.

Related to the above-noted reinforced-concrete papers were three papers dealing with properties of either steel or concrete. The first of these is a paper by Prof. R. C. Carpenter, of Cornell University, on "The Effect of Oil on Cement Mortar." This is a report of a short series of tests made upon neat cement briquettes, some of which were mixed with a small percentage of engine oil, some with linseed oil and some with no oil, and then allowed to set in moist air, and another series of tests made on neat cement and water briquettes which were allowed to set for 8 days in linseed oil and also engine oil. The effect of the oil when mixed with the cement is to retard the hardening process materially, and this retardation is more marked with the linseed than with the engine oil. The soaking of briquettes which were 8 days old for 20 days in oil had no material effect when linseed oil was employed, but had a very marked weakening effect when engine oil was used.

Several other of the members reported small series of tests which they had made upon this same subject. So far as these limited experiments go, there seems to be no visible effect of external oil on hardened concrete, but the presence of oil in the mixing will reduce the strength of the finished mortar to a greater or less extent. The results of the tests are borne out in actual practice by observation of engine-room concrete floors which do not appear to be damaged by the ever present oil, and by the slight reduction in tensile strength shown by briquettes which have been made in molds cleaned with oil not subsequently removed. This latter reduction does not reach a greater amount than 3%, according to the investigator.

In continuation of similar reports in the past two years, Prof. Ira O. Woolson, of Columbia University, read the final portion of his "Investigation of the Thermal Conductivity of Different Concrete Mixtures, and the Effect of Heat upon their Strength and Elastic Properties." The first two portions of this work appeared in Engineering News, Vol. 54, p. 35 and Vol. 55, p. 723. The following summary is interesting:

> (1) All concrete mixtures when heated throughout to a temperature of 1,000° to 1,500° F. will lose a large proportion of their strength and elasticity, and this fact must be well remembered in designing.
>
> (2) All concretes have a very low thermal conductivity and therein lies their well-known heat-resisting properties.
>
> (3) As a result of this low thermal conductivity, 2 to 2½ ins. of concrete covering will protect reinforcing metal from injurious heat for the period of any ordinary conflagration (provided, of course, that the concrete stays in place during the fire).
>
> (4) Reinforcing metal exposed to the fire will not convey by conductivity an injurious amount of heat to the imbedded portion.

(5) The gravel concrete is not a reliable or safe fire-resisting aggregate.

In connection with the last statement (No. 5), Mr. R. L. Humphrey (St. Louis, Mo.) disagreed with Prof. Woolson and stated that the statement was too general. In the laboratory at St. Louis many tests have been made on the fire-resisting qualities of gravel concrete and the material has stood up equally as well as the stone aggregate. It is always well to analyze the character of the gravel submitted for concrete fireproofing, but certain kinds, particularly the grades found in the middle west, are of a fire-resisting nature.

The third one of these papers was by Mr. J. J. Shuman (Pittsburg) upon "Cold Twisted Steel Rods for Concrete Reinforcement." In course of his work as inspector of the testing department of a large steel mill, Mr. Shuman has had occasion to make an extensive series of tests upon cold twisted square steel rods to determine the effect of the size of bars, number of turns, and quality of material used. The results of these experiments together with a proposed specification for cold twisted steel rods are included in the paper. It is shown that the strength of a bar is increased by twisting in proportion to the number of turns. This is due to the permanent set in the metal in the same manner as a higher yield point and ultimate strength are set up in a bar when it is slightly stretched in a testing machine. There is a point of maximum strength, however, which occurs before failure, and beyond which additional turning only tends to twist the bar apart. Bessemer and open-hearth steel are equally good materials to use in cold-twisted work, but when open-hearth is specified it should contain less than 0.04% phosphorus for basic and 0.06% for acid steel. If the carbon content is specified the required tensile strength should be omitted from the specifications and vice-versa, as it is hardly fair to prescribe the effect of a test upon a prescribed material.

CEMENT.

In the section on cement considerable time was spent in reading papers and discussions upon methods to be used in the cement-testing laboratory. The first of these was by Mr. E. B. McCready (Allentown, Pa.) upon "Avoidable Causes of Variation in Cement Testing." He said that it is a well-known fact that tests of the same cement will vary according to the particular laboratory in which they are made and it is the duty of every cement tester to try to reduce this variation to as low a degree as possible. The two great things to which such variation are due are non-adherence to the standardized methods of testing and the personal equation, which latter is largely a result of the former, and a trouble which will be greatly reduced in just such proportions as uniformity of methods is developed. It is unfortunate that many engineers accept results of tests the methods in making which they know nothing about and compare them with tests made under well-known and correct conditions. Until all laboratories follow the same standards as regards not only the general specifications of testing, but also such smaller details as temperature and moisture of the testing room, method of mixing, and consistency of the pat in mixing, the comparative results of two separate laboratories will be of small value. Mr. R. S. Greenman (Albany, N. Y.) in his paper on "Some Problems of a Cement Inspecting Laboratory," cited many instances in support of Mr. McCready's statements. One of the large elements of variation as found in some of his work has been the unreliability of the sieves. In one instance of two so-called 100-mesh sieves one measured 102 meshes to the linear inch and the other 92. Uniform work is impossible under such conditions. He wished to particularly deny one idea that has lodgment in many minds, that the brand of a cement guarantees its efficiency. The successive products of the same mill vary just as much as do two different brands and are in just as great need of testing.

A moisture closet for test specimens, "home"-made of reinforced concrete, was described in a note by Mr. McCready. Such a closet has been made and used with great satisfaction in the Lehigh Valley Testing Laboratory at Allentown, Pa. Along this same line Mr. R. E. Bakenhus (U. S. Navy) presented a short paper describing certain labor-saving devices recently installed in his laboratory, principal among which was an index card upon which all records of tests could be recorded and filed away in a card index.

The subject of testing was finished by a paper "The Control of Physical Test Results in Portland Cement," by Mr. W. A. Aiken (Pittsburg, Pa.) This gave the results of much experimental work to prove that the theoretical content of cement as given by the author two years ago, viz.: Minimum silica, 21%; maximum alumina, 9%; maximum iron, 3.25%; lime, 62.5 to 63.25%, and maximum magnesia, 3%, will furnish material in every way satisfactory and likely to give desired results, low early strength, good gain between 7 and 28 days and best long-time results in standard quartz mortars while similarly proportioned mortars, where a fair natural sand is used, would give better results in every way on account of the better grading of the material.

The rather indeterminate nature of the clause in the 1904 specifications for cement which reads:

Specific gravity is useful in detecting adulteration and underburning. The results of tests of specific gravity are not necessarily conclusive as an indication of the quality of a cement, but when in combination with the results of other tests may afford valuable indications

led Prof. R. K. Meade and Mr. S. C. Hawk to make a series of experiments to determine the effect of burning upon the specific gravity of cement and also the relation of specific gravity to other properties of the material. The results of these tests were presented to the society in the form of a paper, the conclusions of which are as follows:

(1) That the specific gravity test is of no value whatever in detecting underburning, as underburned cement will show a specific gravity much higher than that set by the standard specifications. Underburned cement is readily and promptly detected by the soundness tests and no others are needed for this purpose.

(2) The value of the specific gravity test as an indication of adulteration is much exaggerated. While a large admixture of any light adulterant with the cement would be shown, there is at the same time much slag and also Rosendale cement which could be mixed with cement in large quantities without lowering the specific gravity below the limit of our standard specifications.

(3) That low specific gravity is usually caused by seasoning of the cement or the clinker, either of which improves the product.

(4) That the proposition to ignite the cement sample which fails below specifications and determine the specific gravity upon the ignited portion is of no value because adulterated cements also have their specific gravity very much raised by such ignition.

(5) That the requirements for specific gravity should be omitted from the standard specifications or at least that the clause which infers that low specific gravity is caused by underburning and adulteration should be omitted and that in its place there should be inserted one stating that low specific gravity may, but does not necessarily, imply adulteration as it is in most cases due to seasoning of the cement or storage of the clinker before grinding, both of which are beneficial to the product.

PAINTS, AND THE CORROSION OF IRON.

The subject of paints and preservative coatings is considered so important by the society that a large committee has been at work on it for several years, in the endeavor to learn the main factors in the protective power of paints and the recognition of their value by test. This committee has now under way an extensive service test on the Havre de Grace bridge of the Pennsylvania R. R., as noted above in connection with the committee's report. The closely related subject of Corrosion of Iron was segregated last year by the appointment of a special committee to consider the subject. This committee made no report, but instead a highly interesting paper, entitled "The Corrosion of Iron," was read by Mr. Allerton S. Cushman. The paper was illustrated by some experiments and a large number of excellent lantern-slide illustrations.

RUSTING AS AN ELECTROCHEMICAL PHENOMENON.—Mr. Cushman's paper was a demonstration of the theory that rusting is an electrolytic or electrochemical phenomenon. This involves the destruction of previous theories of corrosion, chief among them the carbonic-acid theory. A starting point is the protection against rusting given by a dip into solutions of chromic acid, chromates or bichromates. Similar treatment protects iron against the deposition of copper which ordinarily occurs when a piece of clean iron or steel is dipped into copper-sulphate soolution. But it is known that chromating renders the iron electrochemically "passive"; this gives a presumption in favor of an electrochemical theory of corrosion. Ocular demonstration of the localized or polarized nature of rusting is afforded by embedding nails or other specimens of iron or steel in agar-agar or gelatine jellies which have been impregnated with phenolphthalein and a ferricyanide salt; the former substance is an indicator of hydroxyl ions, turning red in their presence, while ferricyanide solutions are turned deep blue by ferrous iron in solution. A test as described produces one or more sharply defined blue areas on the iron, while the rest of the iron surface shows a pinkish color radiating out into the jelly. The jelly fixes the products of the action in place so that they can be seen. No rusting takes place over the red areas, but the surface of the iron under the blue areas shows rust; the latter are the positive poles of the electrochemical cell, the points at which iron goes into solution. The formation of an electrochemical cell is due to the fact that different parts of the iron surface have varying potential differences against the solution, on account of their varying content of impurities, the presence of oxide (scale) on the surface, etc. These potential differences were demonstrated by Prof. W. H. Walker, of the Massachusetts Institute of Technology, in the following manner: A thin paraffin plate was pierced with a large number of holes drilled through it; by then fusing this plate to an iron surface, a number of insulated electrodes were formed upon filling the holes in the paraffin plate with electrolyte. The potential difference between any two of these electrodes could then be measured. Large and varying potential differences were found in some plates of iron, while other plates showed more uniform; the former always showed more rapid corrosion in a rusting test.

Mr. M. H. Wickhorst (Aurora, Ill.) described experiments he had made bearing on corrodibility of iron. Taking a given weight of borings, these were dropped into a fermentation tube filled with water. Gas was produced and collected in the closed leg of the tube, the action stopping, however, after a time. The amount of gas collected was greater with the more impure samples. Mr. Cushman remarked that the three tests described: the test he had suggested for measuring corrodibility by the rapidity of action of an acid, the paraffin plate method of Prof. Walker, and the gas-evolution test of Mr. Wickhorst, might prove useful in developing an accelerated test for resistance to rusting.

A related paper, "Influence of Stress Upon the Corrosion of Iron," was presented by Prof. W. H. Walker and Mr. Colby Dill (Boston, Mass.). The authors quote the current opinion that stress changes the electromotive force of iron, for which reason a surface containing differently-strained portions exhibits selective rusting. The experiments of Andrews and Hambuechen are cited; the former found the strained metal to be electronegative to the unstrained part, while the latter found the opposite condition. Both investigations have points of weakness, and the authors of the present paper therefore made a new series of experiments. They used specimens of exceptionally pure Swedish iron, ¼ and ½-in. in diameter, stretched in a testing machine, the middle part of the bar, turned bright, being surrounded by an electrolytic cell containing ferrous sulphate, the potential being measured against a normal calomel electrode. The results are stated by the authors thus:

(1) The magnitude of the potential changes suffered by soft iron when tested in a tension machine below the elastic limit, is exceedingly small. In the majority of cases it was less than 0.0001-volt. The maximum change was 0.0004-volt. This change can have no appreciable effect upon corrosion.

(2) The change, when great enough to be measured, was negative, i e., the strained metal had a slightly less tendency to corrode than the same metal unstrained.

(3) Somewhere above the elastic limit, the potential rises suddenly several hundredths of a volt. The mag-

itude of the increase depends upon the rate of straining and ceases abruptly when the straining ceases.
(4) Measurements upon specimens under torsional stress give results similar to those obtained from tension tests.
(5) Out of a considerable number of specimens strained to breaking, the potential of six reached a constant value shortly after fracture. The difference between the initial and final potentials varied from −0.0019-volt to +0.0077-volt.
We conclude, therefore, that even beyond the elastic limit the corrosion of iron is not greatly affected by stress.

The subject of paints and preservative coatings was discussed in a number of papers. "Priming Coats for Metal Surfaces, Linseed Oil vs. Paint," by Mr. F. P. Cheesman (New York City), gave a strong argument tending to prove that linseed oil (boiled) should never be used for priming a metal surface (shop coat), but paint should be used instead. Briefly, the coat of oil allows rusting to take place under it; it dries very slowly, and by continuing to shrink after the subsequent paint is put on it causes the latter to crack and blister. As a substitute, generally an iron-oxide paint is satisfactory; red lead may sometimes be better, and if time is available for drying a carbon black may be used. Mr. M. McNaughton (Jersey City, N. J.) suggested the fact that boiled oil spreads out ten or more times as thin as paint, to explain the more rapid rusting of metal under it. Mr. C. E. Skinner mentioned the use of deflocculated graphite and silicon monoxide (Monox), both new electric furnace products, as having great value for paint purposes, on account of their extreme fineness and consequent great covering power. Mr. C. B. Dudley confirmed the report of the great fineness of Monox, and remarked that it might prove a substitute for white lead.

Mr. L. S. Hughes, in a paper entitled "Deleterious Ingredients in Paints," discussed the necessity for having all ingredients of a paint chemically inert toward each other. Mr. G. W. Thompson (New York City) suggested that it is also necessary to have the ingredients electrochemically inert with respect to each other, and that this is not always included in chemical inertness. Mr. Cheesman contributed a long discussion on deleterious ingredients. He stated that the use of carbon bisulphide in paints should be prohibited by law, as its fumes are capable of causing stupor, idiocy and death. Concerning adulterants and dryers, he remarked that linseed oil being the cheapest vegetable oil today, mineral oils are the principal cheapeners. If only benzine were used as a dryer, there would be little trouble, but the use of kerosene in substitutes for turpentine is harmful. The harmful effect of some ingredients depends on the proportion in which it is used; for instance zinc made direct from ore, if used straight will cause chalking, while if in moderate amount it will not produce this effect. Near the seashore 50% of zinc may be used, but this amount in paints used inland will cause cracking. Ochre should be kept out of paint specifications entirely.

"Paint Legislation," by Prof. E. F. Ladd, described what is being done by the North Dakota Agricultural College in studying house paints, in connection with the laws passed in that state. The house-paint situation is portrayed thus in the paper:

Probably no less than 70,000,000 gallons of mixed paints are now annually produced and consumed in the United States. Mixed paints are a necessity of our age; they are most convenient for use, the colors easily matched at any time, and it is not strange that the growth has been phenomenal. * * * I am, I believe, prepared to show that about 80% of the manufacturers of paints are misrepresenting the facts to the public; they are deceiving them, misleading them, and in not a few cases defrauding them. This will be well proven by a study of Bulletin No. 70 of the Agricultural Experiment Station when taken in comparison with the literature furnished by the manufacturers themselves.

The paper also said that some zinc-lead paints contain more arsenic than the arsenic wall papers that have already been condemned as injurious to health.

Mr. R. S. Perry read a compendious paper entitled "The Physical Properties of Paint Films," which, however, is not susceptible of abstract here. A paper on "Physical Testing of Varnishes," by Mr. J. C. Smith was read by title only.

Papers dealing with tests of metals were concerned mainly with steel. A paper on bronzes, not on testing, however, was read by Mr. G. H. Clamer, under the title, "The History and Development of the Alloy Practice in the United States as applied to Railway Bearings." We hope to reproduce some part of this paper in a later issue.

Sulphur in steel was the subject of a study recorded by Prof. H. M. Howe (New York City) in a paper "Does Low Sulphur Content Lessen the Segregation of Carbon?" The following paragraphs from the paper state its purpose and conclusions:

We often think of segregation only as concentrating the sulphur and phosphorus harmfully in the upper part of the axis of the ingot; indeed, in case of low carbon steel this is its chief reproach. But in case of high-carbon steel, segregation does the further harm of giving great irregularity of carbon content. If electrical refining processes not only expel sulphur thoroughly, but thereby prevent or lessen the segregation of carbon, this is so much to their good.
In order to answer this question I have examined all the available cases of segregation, about one hundred in number. Briefly, the evidence answers 'No" to our question. In other words, it raises a strong presumption against the belief that low sulphur-content tends to restrain the segregation of carbon, and suggests rather that it has the opposite effect of aggravating that segregation. We can readily understand that it should do this, by favoring wildness, which in turn seems to favor segregation strongly.

Prof. E. L. Hancock (Lafayette, Ind.) reported the results of vibratory tests on staybolt iron. Among other discussion this led Mr. C. B. Dudley to remark that he has been looking forward to the time when the staybolt question would be eliminated by the abandonment of the firebox leg of the boiler; his theory in this is that the firebox is the place to generate heat, not to utilize it, and that the water leg results in chilling and very incomplete combustion of the coal along the sides.

Prof. Gaetano Lanza (Boston, Mass.) made tests of some twenty locomotive connecting rods, the results of which he summarized in a paper entitled "Compressive and Transverse Tests of Steel Connecting Rods for Locomotives." The most definite result of these tests was the showing that the ratio of length to least radius of gyration had no measurable influence on the column strength of the rods tested. This ratio, in the tests given, varied from 100 to 150 (based on minimum radius of gyration at the least section). The ratio of ultimate compressive strength to tensile elastic limit varied from 1.09 to 0.80, and the ratio of ultimate compressive to ultimate tensile strength varied from 0.39 to 0.48.

A paper by Mr. F. P. McKibben (Boston, Mass.) on "Tension Tests of Steel Angles With Various Types of End Connection," gave results additional to those presented by the author last year, as reprinted in our issue of July 5, 1906, p. 14.

A paper "Notes on the Endurance of Steels under Repeated Alternate Stresses," by Mr. J. E. Howard (Watertown, Mass.), contained the showing that of steels of various carbon contents, those having 0.73 and 0.82% carbon showed the best endurance under alternating stresses applied by the rotation method. Other factors are referred to as follows:

Elastic properties only are displayed by steels, prior to rupture, when rupture is caused by a large number of alternate stresses of tension and compression. No appreciable display of ductility, as shown by elongation and contraction of area, need precede rupture, in any grade of steel, following the application of stresses of this kind.
If the fiber stresses somewhat exceed the tensile elastic limit a limited display of elongation, other than elastic, may occur, but rupture caused by loads which are in the vicinity of or below the tensile elastic limit is not attended with an appreciable display of ductility.
There is a certain limit, experimentally ascertainable, and except in a general way it would seem not otherwise, above which a comparatively small number of repetitions will cause rupture, while under lower loads the limit of endurance is greatly prolonged.
The relation of this divisional line to the properties displayed in the tensile test, present information is thought to be inadequate to define.
Efforts made to prolong the limit of endurance by occasional annealing the metal have not been successful. Further efforts, however, will be made in that direction since it is a matter of much interest to acquire information concerning the manner in which rupture is approached and accomplished by loads so much inferior to those which are required when once applied.

The Watertown tests were made on specimens 33 ins. long, generally 1 in. in diameter, mounted in a machine like a lathe and loaded at the middle by a weighted lever resting on a bearing 4 ins. long. The speed used is 500 r. p. m., but arrangements are being made to test at much higher speeds, by using a small De Laval turbine. Mr. James Christie (Philadelphia, Pa.) raised the question whether it is clear that the alternation of stress in such a rotating bar is similar to the action taking place in say a bridge post carrying reversing stress; but this question received no answer. Prof. Mansfield Merriman referred to the more than 30 years since Wöhler's pioneer experiments were made, and to the almost complete disappearance of "fatigue" allowances from bridge specifications. He suggested that fatigue is a more expressive word than endurance.

A different type of rotative fatigue-test machine was described by Mr. Henry Souther in a paper on "The White-Souther Endurance Machine." The specimen here is held in the center, on a 3-in. enlarged length, in the hollow center of a pulley which rests in ball-bearing collars. The two projecting ends, about 5 ins. long and suitably shaped, carry at the outer ends ball-bearing collars from which weighted rods are suspended. A revolution counter at each end completes the machine.

Upon the question of Prof. W. K. Hatt, induced by a statement in the paper, asking what evidence there is to show that brittleness is revealed by the endurance test, Mr. Souther replied that in bicycle and automobile work it has been found that the metals which showed up well in the endurance machine also gave good service on the road. Prof. Lanza expressed the belief that sooner or later many specifications will be so drawn as to include endurance requirements.

A paper by Prof. E. L. Hancock (Lafayette, Ind.) on "Effect of Combined Stresses on the Elastic Properties of Steel," dealt with the continuation of work reported in two prior papers of the same author. The conclusions of the present series of experiments, briefly put, are:

Either tension or compression combined with torsion lowers the elastic limit in torsion. Combined flexure and torsion lowers the elastic limit in flexure, but the lowering is less than for other cases of combined stress. The unit deformation at the elastic limit of the tubing tested in tension-torsion and compression-torsion is lowered. The deflection, at the elastic limit, of the steel shafting tested is made less when the torsion is increased. The modulus of elasticity, both in torsion and flexure, is lowered slightly by the presence of combined stresses. The maximum shear on any internal plane should control in design of parts subjected to combined stresses.

Four papers on instruments for testing were read at the last session. Mr. L. W. Page (Washington, D. C.) described "A New Impact Machine," intended mainly for stone and the like. Mr. Clifford Richardson and Mr. C. N. Forrest (Long Island City, N. Y.) described their latest penetrometer in a paper entitled "The Development of the Penetrometer as Used in the Determination of the Consistency of Semi-Solid Bitumens." A double-ended caliper with pairs of legs of greatly different length, recommended for use in finding the elastic limit, was described by Mr. J. A. Capp (Schenectady, N. Y.) in a paper "Multiplying Dividers for Locating the Yield-Point." For measuring distortion, deflection, etc., in a variety of tests, Prof. H. F. Moore (Madison, Wis.) has designed a new type of instrument, consisting essentially of a dial with pointer moved by a fine silk-covered copper wire passing over a 1-in. drum on the axis of the pointer. He described several forms of this apparatus in a paper entitled "An Instrument for Measuring Deformation of Materials."

Other papers presented at the meeting were "The Structural Materials Testing Laboratories, U. S. Geological Survey: Progress during the year ending June 30, 1907," by R. L. Humphrey (St. Louis, Mo.); "Effect of Conditions of Rolling on Certain Properties of Steel," by Prof. H. M. Howe and Mr. William Campbell (New York City); "The Heat Treatment of Steel," by Mr. William Campbell; and "The National Bureau of Standards," by Mr. S. W. Stratton (Washington, D. C.). Of these the two papers on steel were read by title only.

THE TESTING OF BRAKE SHOES: REPORT OF COMMITTEE OF THE MASTER CAR BUILDERS' ASSOCIATION.

At the 1906 convention the Executive Committee of the Master Car Builders' Association was authorized to investigate the question of further improving the brake shoe testing machine so that wearing tests might be made in addition to the study of frictional qualities which at that time was the sole basis of investigation. At a meeting of this committee held later in the year this was fully discussed and as a result it was decided to revise the testing machine and to devote the entire work of experimentation during the current year to the study of the wearing qualities of brake shoes.

The original testing machine as used merely to measure frictional values is described in the report as follows:

> By its use a standard brake shoe may be made to act upon the face of a revolving car wheel mounted upon the same shaft with a heavy fly-wheel. The car wheel to which the shoe is applied may be either steel-tired or cast-iron, and is ordinarily 33 ins. in diameter. A double-cylindered steam engine serves to set the machine in motion. The pressure with which the shoe is made to act upon the car wheel is regulated by weights applied to a system of levers, while the tangential pull resulting from the application is recorded upon a paper scroll by an Emery testing machine. These functions permit an accurate observation of the frictional properties of any shoe upon any wheel of standard dimensions. As a result of its work with its brake-shoe-testing machine the association has formulated specifications which define the minimum coefficient of friction to be developed between the shoe and the wheel in making a stop under various brake shoe pressures from prescribed rates of speed and has from time to time conducted tests for the purpose of establishing the frictional qualities of shoes which are being supplied railway companies. The process of testing is laborious and slow.

It was at first thought that it would be impossible to so adjust or revise the old machine as to make tests on wearing qualities practicable, but by careful study a suitable attachment was devised. The difficulty to be overcome was a constant application of the brake shoe to the fixed car-wheel on account of the high temperature and consequent ill-effects which would result. In order to closely approximate the actual conditions of brake shoe and wheel on a train an addition to the testing machine had to be constructed in which the contact between the two should be of a short duration.

> The purpose of the proposed addition would be to permit the shoe to be brought in contact with the wheel of the testing machine for a predetermined interval, after which it would be automatically released, remaining in release position for another and a much longer interval, during which time both wheel and shoe would return to their normal temperature. It was believed that by such a cycle any shoe could be given a definite amount of exposure to wear, that a comparatively short interval during the application and a much longer one during the release would avoid all chances of excessive heating, and that by its automatic action the motion of the machine could continue hour after hour, with but little attention from the laboratory attendants. Accessory to the large machine there would of course be required a registering counter to show the number of applications, and a delicate balance for weighing the shoes before and after they are exposed to the action of the machine.

This automatic cut-out arrangement was first designed to be actuated by means of cams, but this necessitated such heavy machinery with so high a cost that a second design was made. In the second design, made by Prof. W. P. Turner, of Purdue University, compressed air was employed to bring about the required movements, the supply and discharge being governed by a light and comparatively inexpensive valve driven by a gear connection with the testing-machine shaft. This device has worked admirably and with the apparatus the brake shoe testing machine may be run steadily at any given speed, the shoe being automatically applied and released.

The committee selected 15 shoes on which the regular frictional tests had been made in 1906 and reported upon at the last convention and used these shoes for the wearing tests of this year. The machine was set under the control of a gear which required 800 revolutions for a complete cycle, during 190 of which the shoe was in contact with the wheel. It was found that by employing a speed of 20 miles per hour and a brake-shoe pressure during application of 2,808 lbs., the machine could be kept in continuous motion under the cycle without undue heating either of the wheel or shoe. The severity of test conditions may be judged by the fact that the work done by the brake shoe during each application is approximately the same as that which would be done by each of the eight shoes of a loaded 160,000-lbs. capacity car in bringing the car to rest on a level track from a speed of 40 miles an hour.

The accompanying table shows the results of these tests. In commenting upon these results the committee's report says:

> It is apparent that no measurement of wear is complete which does not take into account the frictional qualities of the shoe; that a true measure must include both wearing and frictional qualities and this is best expressed in terms of energy absorbed per unit of weight of material lost. Assuming that the conditions affecting the exposure of the shoe to wear are equally fair to all shoes tested, comparisons upon this basis should constitute a satisfactory measure by which to determine the relative value of the different shoes.
>
> In carrying out the tests all shoes were subjected to the same exposure to wear. Whether the relative results would be the same had the conditions of test involved lighter pressure or higher speeds than those which were actually employed, is a question which the committee has not yet had time to determine. It is not impossible that a shoe giving a relatively poor performance under the conditions of the test would show relatively better under some other conditions. If, for example, shoes are designed for specified service, it would perhaps be unfair to expect all to show at their best under a single condition of operation. The probability is, however, that a shoe which is good under one condition of running will not be bad under other conditions. But, as has been stated, these are questions which have not been studied, and the results as set forth in the accompanying table should be accepted, not as an absolute measure of the relative values of the shoes in question, but rather as an exhibit of facts obtained by a process which is clearly described and the significance of which each member will be able to judge for himself. They illustrate the sort of information which can be secured.
>
> In future tests the committee intends to measure the wear and tear on the wheel used in the testing, a factor that heretofore has not been studied in any of these experiments. It is also expected that chemical analyses of the shoes will be made in an effort to determine the exact nature of the brake-shoe problem.

TABLE OF BRAKE SHOE TESTS.

Wear of Brake Shoes on Cast-Iron Wheels—Speed constant at 20 miles per hour; pressure of shoe on wheel, 2,808 lbs.; revolutions of wheel during application, 190; equivalent distance run during application, 1,641.5 ft.

Number of shoe.	Coefficient of friction.	Weight of shoe, lbs.	Number of applications.	Total loss of weight, lbs.	Loss of weight per application, lbs.	1,000,000 ft.-lbs. of work absorbed per application.	Do. per pound of material lost.
158	22.5	22.046	90	.229	.002544	1.036	407.2
161	21.8	21.208	94	.644	.006850	1.004	146.6
163	21.7	19.964	118	.337	.002856	1.000	350.1
172	22.8	17.180	90	.366	.004066	1.050	258.2
175	30.3	11.202	40	.690	.017250	1.395	80.8
178	20.0	18.662	90	.364	.004044	.921	227.7
179	36.8	9.298	40	.593	.014825	1.695	114.3
183	38.7	7.846	60	.615	.010250	1.782	173.8
186	24.1	13.778	90	.615	.006833	1.110	162.5
194	26.5	22.730	90	.198	.002200	1.220	554.6
200	22.7	15.780	90	.243	.002700	1.045	387.0
205	23.5	17.610	90	1.058	.011755	1.082	92.0
209	24.7	16.818	90	.593	.006588	1.137	172.0
215	20.9	16.354	90	.320	.003555	.963	270.9
220	26.5	13.066	91	.220	.002417	1.220	504.7

THE EFFECT OF OIL ON CEMENT MORTAR.*

By R. C. CARPENTER,† M. Am. Soc. M. E.

I have been unable to find any references to tests showing the effect of oil on concrete,‡ although the question is often of considerable importance in connection with foundations for machinery. I find that the impression is frequently held among engineers that oil used in machinery is injurious to concrete foundations.

In order to ascertain the effects of oil on concrete, Mr. Sawdon, an instructor in the Mechanical Laboratory of Sibley College, Cornell University, made the following investigations which, although not sufficient to fully decide the matter, will I believe throw some light on the question.

The experiments were conducted by making briquettes of neat cement to which 2% of oil was added in addition to the water. These briquettes were tested for tensile strength at the end of 24 hours, 7 days and 28 days. As a basis of comparison, a test was also made of briquettes made from the same cement in the same manner without the addition of oil.

Another series of tests was made on normal briquettes of neat cement which were kept in water 8 days, after which they were soaked in oil for 20 days. The following gives the results of the various tests in tabular form:

TABLE I.—SOUNDNESS PATS—NEAT CEMENT.

No.	Treatment.	Test.	Results.
*1	1 day in moist air.	Boiled 3 hrs.	Sound
*2	1 day in moist air.	8 days in linseed oil.	Sound
*3	1 day in moist air.	8 days in engine oil.	Sound
†4	1 day in moist air.	Boiled 3 hrs.	Sound
‡5	1 day in moist air.	Boiled 3 hrs.	Sound

*Without oil, 23% water.
†23% of water, 2% linseed oil.
‡23% of water, 2% of engine oil.
All the pats adhered to the glass plate.

TABLE II.—TENSION TESTS OF CEMENT MORTAR IN OIL.

	Days in Air.	Days in Water.	Strength in lbs. per sq. in. Earth Test.	Average.
Neat Cement, 23% water, no oil. Allowed to set 24 hours in moist air.	1	0	753	430
	1	6	640	696
	1	27	735	743
	1	27	751	
23% water, 2% linseed oil. Allowed to set 24 hours in moist air.	1	0	190	180
	1	0	170	
	1	6	455	493
	1	6	532	
	1	27	618	572
	1	27	525	
23% water, 2% engine oil. Allowed to set 24 hours in moist air	1	0	320	332
	1	0	345	
	1	6		689
	1	27		696
Neat Cement, 23% water, no oil. Allowed to set 24 hours in moist air, 10 days in water and 8 days in oil.			Linseed oil	720
			Engine oil 692	673
			Engine oil 655	....

TABLE III.—SUMMARY OF RESULTS.

	Lbs. per sq. in. 24 hrs.	7 days.	28 days.
Neat cement, no oil	430	696	743
Mixed with 2% linseed oil	180	493	572
Mixed with 2% engine oil	332	687	696
Soaked after 8 days in engine oil	...	...	673
Soaked after 8 days in linseed oil	...	...	720

Considering the results of this experiment, it is noted that the effect of the oil when mixed with the cement is to materially retard the hardening process, and this is more marked with the linseed oil than with the engine oil. Even at the end of the 28-day period the briquettes mixed with 2% oil were materially weaker than those without oil, although of sufficient strength to pass most specifications.

The soaking of briquettes which were 8 days old, for 20 days in oil apparently had no material effect when linseed oil was employed and had a sensible weakening effect when engine oil was used.

The results of the tests referred to are being supplemented by more extensive tests not yet completed. It will be noted in connection with these tests that adding 2% of oil to the cement did not effect the soundness test.

THE "TERRIBLE" MINE at Cripple Creek, which has for several years been abandoned on account of water the accumulation of which is estimated at 40,000,000 gals., is reported as being about to be reopened. The output of the mine is lead. At the 250-ft. level a vein 90 ft. wide was struck, and before abandonment large quantities of ore—mainly pure cerussite, or carbonate of lead—were taken out.

THE DRAINING OF MINES BY AN EARTHQUAKE possesses novel features of economy to those who are familiar with the enormous expense incident to mining pumping. From an Idaho paper we note that the phenomenon has been recorded in that district in connection with the recent visit of Mr. E. C. Edwards, a New York mining man, to inspect the Blue Jacket mine in the Seven Devils district. It is said that in some of the deeper mines of the district, out of the mouths of which water had been flowing prior to the San Francisco earthquake, the water level has been constantly diminishing since that time; and in the Blue Jacket, which Mr. Edwards visited for the purpose of investigating the cost of pumping, it was 12 or 15 ft. below the mouth of the shaft and gradually sinking.

The explanation offered by local mining men is that the earthquake shock affected underground strata and opened fissures into which the water is slowly draining.

*Paper read at Annual Meeting of American Society for Testing Materials, Atlantic City, June 20-22, 1907.
†Professor of Experimental Engineering, Cornell University.
‡A very extensive series of tests upon the effect of oil on concrete by Mr. J. C. Hain, Engineer of Masonry Construction of the Chicago, Milwaukee & St. Paul Ry, appeared in Engineering News, Jan. 16, 1905.

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Every engineer interested in reinforced concrete construction—and what engineer nowadays is not?—will study with interest the account in this issue of the construction of several reinforced concrete buildings at the Edison cement works by casting the members and erecting them later. No one mindful of our rapidly diminishing timber supply can view the present method of concrete building construction, with its enormous waste of lumber in forms, and consider it a final solution of the problem of economic construction of buildings.

Apart from the saving in form work, however, there are other advantages in making columns, beams and slabs on the ground instead of molding them in place. For one thing, the quality of the finished concrete should certainly average very much better than is the case with concrete molded in place. The workmen can do far better work, placing reinforcement and filling forms on the ground than they can do on top of a high staging; and with a small part of the inspecting force, the engineer can keep close watch on all the operations. The molds are truer, less likely to warp and leak, and it is much easier to secure a good surface finish. Further, the engineer can see each beam and column as it comes from the mold and is handled in erection. Any gross defects will be apparent and the handling in erection is of itself a test of some value for revealing weak spots due to defective work.

It is true, of course, that the size of the hoisting apparatus necessary to raise heavy members into place would tend to restrict the use of the system; but if such apparatus were available, we should suppose the cost of erection of the completed members would be no more, and very likely less, than the cost of transporting concrete from the mixer to the various points of deposit, in the ordinary method of building erection.

The objection may be raised to this method of construction that the joints are weak; notwithstanding the grouting at the junction of girders and columns; but if greater stiffness is desired, it would not be difficult to cast brackets or knee-braces at these points of junction, molding projecting reinforcement in columns and beams to make sure the connection.

The London "Statist," one of the leading financial journals of Great Britain, accompanied its issue of June 15 with a 96-page supplement devoted to a review of the financial condition of American railway enterprises.

With reference to the prospects for general prosperity for American railways, the "Statist" reaches the same conclusions as those set forth in these columns last week, viz.: That the reaction in the price of sound securities is not a forerunner of trade depression; but that a continuance of business activity may reasonably be expected. It sums up the general outlook as follows:

> Apart from the necessity to reduce somewhat the rate of the total capital expenditures in order not to outrun the supply, the United States are likely to maintain their great prosperity. There is no lack of demand either at home or abroad for the productions of the country. The annual amount of real wealth produced is of colossal extent, the purchasing power of all sections of the country has never been greater, the stock of money is unequaled in extent and is yearly being increased by large productions and by imports of gold, individuals are more free from debt than they have ever been, and corporations have been careful to raise capital by stock rather than by bond issues, and by using profits for capital purposes they have greatly added to their financial strength. Indeed, at no time in the history of the country have the underlying conditions making for permanent prosperity been as sound as they are at the present time; and any slackening in the rate at which trade has recently been growing, arising from the diversion of capital from one industry to another, or resulting from the necessity of restricting the capital outlays to the supply, or from any of the other influences which will probably cause the rate of growth for a time to diminish, will be of quite a temporary character. In brief, we look for the rate of expansion merely to moderate until after the next presidential election, when it will probably again become as great as it has been in recent years.

In the early days of railway building in the United States, a large proportion of the capital required was obtained from abroad. "The Statist" estimates that up to 1893 nearly one-half the capital expended on United States railways was obtained from foreign sources. This is probably a large overestimate; but it is of course true that a vast amount of English and German money was invested in American railways. It is also true that since 1893 the influx of foreign capital to the United States has greatly diminished. The explanation which "The Statist" gives for this falling off is ingenious. We quote further from the journal as follows:

> But the inflow of foreign capital practically ceased with the currency crisis of 1893, and the losses which fell upon foreign investors in consequence of that crisis prevented them from finding fresh capital for American railway construction for many years. The effect of the currency crisis has been that since 1893 the people of the United States themselves have had to provide practically the whole of the capital needed for the development and expansion of their transportation facilities, whereas previously they had only to find something more than one-half of the sums required.
>
> Fortunately for them, at this moment a railway president—Mr. James J. Hill—discovered a new method of providing a vast quantity of additional transportation facilities without the expenditure of any appreciable amount of fresh capital. During the crisis Mr. Hill discovered that a much greater amount of traffic could be conveyed per mile of single track by means of high-capacity wagons and engines of great power than by the relatively small capacity freight cars and light engines previously employed. In consequence of this discovery it was found unnecessary to expend any very large amount of additional capital in order to deal with nearly double the amount of traffic. Hence from 1893 to 1905—a period in which the new economical methods of railway operation were being introduced—the American people had to provide only a very small amount of capital for railway purposes, and did not need to import capital from abroad.

Probably no one will be more surprised than Mr. Hill himself to learn that he was the original discoverer of the economy of high capacity cars and high-power locomotives. We need hardly say to our readers that the growth in size of cars and locomotives dates far back of 1893, and has been a process of evolution in which all American railways of heavy traffic and all progressive railway officers have participated. While the increased size of rolling stock has been of considerable value in helping our single track railways to cope with heavy traffic, it does not go very far to explain the falling off in the demands upon foreign capital by American railways. Exactly the same influences were at work during the '80's, when the change from the 20,000-lb. car of the '70's to the 50,000-lb. and 60,000-lb. car of the early '90's was being made, yet heavy drafts were made on foreign capital in those years.

It seems to us that the falling off in the influx in foreign capital since 1893 is due simply to the operation of the well-known laws of supply and demand. Following 1893, the railways' demands for new capital fell off. With diminishing traffic there was little need for expansion. The lack of demand for capital lowered the current rates of interest on stocks and bonds to 3% or 4%, a rate no greater than foreign investors could obtain on securities at home. Those who desired larger returns turned their attention to investments in new enterprises in South America or Africa or Asia or Australia.

In the fourteen years since 1893, the United States' own production of capital has been to a large extent sufficient for its requirements; and it has even contributed large amounts to the development of enterprises in foreign countries. During that time Europe's surplus capital production has been largely absorbed in the development of its own local industries, in Colonial enterprise and in the financing of the South African and Russo-Japan wars.

The present outlook, however, according to "The Statist" is for a large surplus production of capital in England and other European countries. In the United States at the same time, the demand for capital has raised interest and dividend rates to a point where they are again attractive to foreign investors. It is probable, therefore, as "The Statist" says, that a renewed flow of foreign capital to this country can be reasonably expected.

The use of concrete for oil tanks, which is described by a correspondent in this issue, brings up the question of the possible disintegrating effect of oil upon concrete. In our issue of Mar. 16, 1905, we published details of a series of tests made to determine this point, under the direction of Mr. J. C. Hain, Engineer of Masonry Construction of the Chicago, Milwaukee & St. Paul Ry.

On another page of this issue appears a paper read by Prof. R. C. Carpenter before the American Society for Testing Materials upon "The Effect of Oil on Cement Mortar." The tests upon this subject have not been extensive enough to warrant any decisive statement upon the question for the results show a decided disintegrating effect upon some samples and briquettes, while others show little or no sign of being affected. Investigations of concrete structures also show extremely varying conditions. In some cases oil has penetrated as far as half an inch, while in others the penetration is very slight, and the saturated portion appears to be as sound as the rest. The investigations indicate that most oils penetrate concrete mortar, and that the effect of oil is greater upon concrete which is of inferior quality.

The concrete oil-tank described by our correspondent has apparently already been built, and in our issue for Jan. 3, 1907, p. 13, we published a description of some similar oil-tanks that had been installed in the new shops of the El Paso and Southwestern Ry. at El Paso. In this latter case extensive tests were entered into to determine the ability of the concrete to withstand the attacks of the oil, and it was decided finally that there was absolutely no danger of either leakage of the oil or deterioration of the concrete. It will be of interest to observe whether these and other concrete tanks for holding oil show any surface disintegration after years of use.

Agitation to secure the passage by Congress at its next session of the bill creating the Southern Appalachian and White Mountain forest

reservations, is being carried on by the American Forestry Association. The importance of the measure, for the protection of the mountain slopes from erosion and consequent serious injury to the waterways as well as for the conservation of the waning timber supply, can hardly be overestimated. The subject is familiar enough to every member of the engineering profession to enlist hearty support without question.

THE RAIL SPECIFICATION OF THE AMERICAN SOCIETY FOR TESTING MATERIALS.

Very general surprise, coupled with disappointment, must have been caused by the action taken at the recent meeting of the American Society for Testing Materials in accepting the steel rail specification presented by its Committee A.

It is only a year ago that this committee received what almost amounts to a rebuke for its failure to report a radical specification for rails. At that meeting it presented a complete specification, the result of some four years' work, only to be answered by a resolution to recommit, with instructions to prepare a specification:

which will give promise of correcting as far as possible the defective quality of rails obtained under existing specifications.

After such a rebuff one would hardly expect the committee to return this year with substantially the same specification. Yet that is precisely what it did: the committee's 1907 specification differs from its 1906 specification in two points only, and in one of these the change is practically a rephrasing, no more.

To venture the assertion that the new specification would produce different rails, or correct any "defective quality" which the old specification does not guard against, would be a bold step. Of course the committee did not attempt any such assertion. It knew that its latest specification sets the same high limit for phosphorus, is as non-committal in regard to cutting the bad top off the ingot, has the same laxity in its drop-test requirements, is equally as silent on the subject of small reduction per pass and thorough working of the metal in rolling, as the rejected specification of 1906.

Nor, on the other hand, did the committee offer any excuses for its failure to comply with its instructions. It merely said, in effect, "Here is our report, gentlemen. It is the best we can do." Plainly, the committee was tired, or perhaps we may say it exhibited fatigue from repeated alternating stresses. It had reached the end of its work; it had fought over the same ground so often that all realized that neither side could gain there. Nothing was left but to stop fighting: either agreeing or disagreeing, sending up either a compromise report or separate opposed reports. The former course was chosen.

The surprise lay not so much in the action of the committee, however, as in the resulting action of the society, which squarely reversed its action of last year. Upon receiving the committee's report, and after hearing a lively discussion on rail failures, the hundred or so assembled members voted to accept the specification and pass it to letter-ballot.

They voted this way in disregard of the fact that the past winter has seen the rail question suddenly raised to a position of national importance; that everyone, engineer and layman, is looking for an authoritative pronouncement as to means for securing better rails; that a thorough canvass of the question is shortly to be made, with the probable sequel of material changes in commercial requirements in rail contracts; and in disregard of the further evident fact that, whatever the outcome will be, whether the decision is for Bessemer or for open-hearth steel, for or against more careful rolling, for new standard rail sections or the retention of the old, in any case the specifications accepted by the society will fail.

The society knew that, whatever may be the trouble with some or all of the rails of to-day, its specification approves and accepts those rails, good and bad; and that to ensure the elimination of the defective rails, another specification will be needed. The society realized that, while its aim is to establish specifications that will commend themselves to general adoption and use, this rail specification may possibly never govern the rolling of a single rail order. Thus in the acceptance of this specification, the basal principles of the society's work were disregarded.

The situation is anomalous to a degree. And, as in all such anomalies, there are perfectly natural causes back of it. We do not mean to say that it is a thoroughly satisfactory situation, but we do not purpose here to pass opinion on it. The situation finds its chief cause in the very circumstance that helps to make it appear anomalous: in the prominence given to rail fractures during the past few months and the resulting widespread agitation for improvement. Had this condition not arisen, Committee A would have had the clear duty of working out a specification satisfactory from the user's point of view and in accordance with the instructions given by the society at its 1906 meeting. It is true, it was known even last year that the manufacturers' representatives in the committee had conceded all that they were (or would be) authorized to concede toward a commercial specification. But if no further progress toward agreeing on better requirements could be obtained, the committee could have made a divided report, setting forth the ultimate limits of concession of both sides, and explaining the views which fixed these limits. To do this would have been the course of duty of the committee, and we must assume that they would have followed this course.

But under the conditions as they have shaped themselves recently, with preparations already made for consideration of the subject by men higher up in both the railway and the rolling-mill organizations, and with everything tending toward a revision and possible unification of existing specifications, this course was no longer the only proper one to be pursued. The committee faced the condition of seeing its work taken away from it by more powerful, if less able, authorities.

Knowing that if its past labors were to have any fruit their results must be put together and reported now, it recognized that the most valuable result it could show are the compromise requirements which it had agreed on: the best specification to which the assent of the rail-makers' representatives had been secured. This specification represents, not the best obtainable product, but the best obtainable product under the commercial conditions of to-day and at the prices prevailing to-day. Other authorities might or might not determine officially what requirements are demanded as a minimum limit for safety, and how much must be conceded in price to meet these requirements. In either case they would have before them, in the specification drawn by Committee A, a record of the highest quality corresponding to present-day commercial conditions.

On the other hand, the society's action in voting to accept the specification can equally be justified. The committee's conclusions as such, without the approval given by the society's acceptance, would be no more than a private utterance; with that approval, the specification stands before the world clad with authority. In the work of harmonizing and improving that will be done in the near future, the specifications of the American Railway Engineering and Maintenance of Way Association and of the American Society of Civil Engineers will each claim consideration from their official character. If the work of Committee A was to receive equal consideration, it needed equally its society's official acceptance; otherwise the first steel-rail specification of the society, drawn seven years ago, would be the official representative of the American Society for Testing Materials. This sentiment, a very natural one, was revealed, for example, in the words of President Dudley in supporting the motion to accept. It explains why Mr. Dudley, whose presidential address argued convincingly against retests of material after failure in the first test, and in favor of testing every heat of Bessemer steel, gave his advocacy and his vote to a specification that explicitly permits retests and provides for testing only one out of five blows of the converter.

LETTERS TO THE EDITOR.

The Highest Pile-Driver?

Sir: I send you a photograph of a pile driver which is 99 ft. under the head block. This driver is in use driving piles from 80 ft. to 115 ft. in length for a viaduct across Sullivan Gulch, at Portland, Oregon. So far as the writer knows, this is the highest pile driver ever built, and it may, therefore, be of interest to your readers.

If you know of anything higher, I should like to learn of it through your columns. You will note the ladder

A 100-Ft. Pile Driver in Use at Portland, Oregon.

of the old leads, which were 45 ft. in height, and which will give a better basis of comparison than anything else in the picture. Very truly yours,

International Contract Co.,
C. E. Fowler, President.

737 New York Block, Seattle, Wash., May 16, 1907.

Cribwork for Closing a Washout.

Sir: On a line of railway in this country loaded passenger and goods [freight] trains were run over a river on single bird-cages [cribs] built of sleepers [ties] 7 ft. 10 ins. × 5 ins., laid on the gravel bed of the stream which was almost dry. The rails were laid on longitudinal balks [stringers] where a bridge had been washed away, the gap between abutments being about 172 ft. and 20 ft. high. The line is the standard gage of this country, 3 ft. 6 ins.

I should like to have the opinion of some of your engineers as to the safety of this proceeding, and if such a thing would have been allowed in the States. There is no Board of Trade here. I stated that, in my opinion, it was very unsafe, but the company held the opposite view and continued running for a period of some three months without an accident.

"Assoc. M. I. C. E., England."

Worcester, Cape Colony, May 22, 1907.

[Cribs filled with stone, or even with earth, should be safe enough for a temporary line across a washout if well bedded. In American wrecking practice, piles would be used almost invariably in preference to cribs. Less material is required and the line can be completed and put in operation sooner. Further, the road built with piles can stand much heavier flood than one supported on cribs.

So far as government supervision over safety is concerned, the separate states, or a few of them, make some pretense of inspection and control over track changes affecting the safety of travel.

But it is for the most part little more than a pr[illegible]se.

The contrast between the English terms in our correspondent's letter and the American terms, which we have added in brackets will be noticeable to the reader.—Ed.]

The Standley Lake Dam and the Gatun Dam.

Sir: Referring to the news item in your issue of June 20, p. 697, where you describe "The Largest Earth Dam Ever Built" to be undertaken at Standley Lake, near Denver, Colorado:

Your description of this dam is that it will be 1¼ miles in length and 150 ft. in height, and "will thus be a far larger structure than the Gatun dam at Panama."

The proposed dam at Panama will be 7,800 ft. in length, nearly 1½ miles; will be 100 ft. in thickness on the top and ½ mile in thickness at the base; it will be 135 ft. in height above mean low tide, which means something over 150 ft. total height. It will form a lake with an area of something over 200 sq. miles, or more than 128,000 acres, and the construction of the dam will require the placing of over 21,000,000 cu. yds. of material.

In view of the above figures, it will be very interesting to know how you make the deduction that the proposed dam near Denver is to be "a far larger structure than the proposed Gatun dam . . . . ."

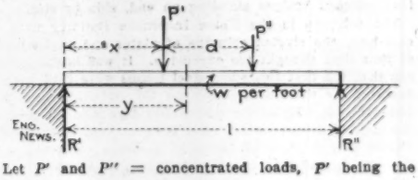
Truly yours, Jno. F. Stevens.

New Haven, Conn., June 25, 1907.

[Our apologies are tendered to the Gatun dam and the engineers responsible for it. What the writer of the note had in mind was the fact that the elevation of the lake formed by the Gatun dam is only 85 ft. above sea level. The total height of the dam, however, is of course much greater, and as shown by Mr. Stevens, in length, width and cubic contents the Gatun dam will far exceed the other.—Ed.]

Live Load Moments in Highway Bridges Carrying Road Rollers.

Sir: In the design of small highway bridges the determining factor is in most cases the live load produced by a passing road roller or traction engine, consisting of two concentrated loads at a fixed distance apart. For such a specification the critical location of the loads may be determined as follows:



Let P' and P'' = concentrated loads, P' being the larger;

w = dead load per unit of length;

l = clear span;

d = fixed distance between P' and P'';

x = distance from the nearest abutment to P';

y = distance to the critical section;

R' and R'' the abutment reactions;

M = the maximum bending moment.

Then M occurs under P', where

$$x = y = \frac{2P'l + 2P''l - 2P''d + wl^2}{4P' + 4P'' + 2wl} = \frac{l}{2} - \frac{P''d}{2P' + 2P'' + wl}$$

$$\text{and } M = \frac{wly}{2} - \frac{P'y^2}{l} - \frac{P''y^2}{l} - \frac{wy^2}{2} - \frac{P''dy}{l} + P'y + P''y$$

These formulas are proved as follows: Take moments about the righthand end.

$$R'l = \frac{wl^2}{2} + P'(l - x) + P''(l - x - d)$$

$$M = R'y - \frac{wy^2}{2} - P'y + P'x$$

$$= \frac{wly}{2} + P'x - \frac{P'xy}{l} + P''y - \frac{P''xy}{l} - \frac{P''dy}{l} - \frac{wy^2}{2} \quad \ldots\ldots\ldots (1)$$

By inspection of the figure it is seen that y cannot be less than x; and for d not greater than $\frac{l}{2}$, x must have a positive value. Inspecting the equation (1), it is seen that M is a linear function of x; hence the maximum value of M must lie in a limiting plane intersecting the M-X plane, either $x = y$ or $x = 0$. But P' is the larger load; hence $x = 0$ cannot give the maximum, and therefore the maximum will lie in the plane $x = y$. Making $x = y$ in Eq. (1) and differentiating.

$$\frac{dM}{dy} = \frac{wl}{2} - \frac{2P'y}{l} + P'' - \frac{2P''y}{l} - \frac{P''d}{l} - wy + P' = 0 \quad \ldots\ldots\ldots (2)$$

$$y = \frac{2P'l + 2P''l - 2P''d + wl^2}{4P' + 4P'' + 2wl} \quad \ldots\ldots\ldots (3)$$

For $P' = P''$ and $w = 0$, (3) becomes

$$y = \frac{l}{2} - \frac{d}{4}$$

for values of d up to $d = (2 - \sqrt{2})\, l = .586\, l$

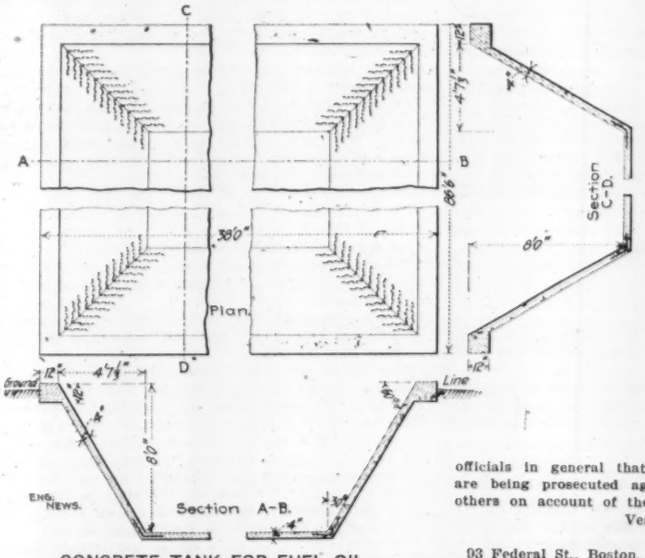
John Howard Ford.

San Fernando, Pampanga, P. I.

A Concrete Tank for Fuel Oil.

Sir: I send you a drawing of a concrete tank designed for the Tonopah Mining Co. for the storage of fuel oil, which is the fuel used by the company at its power plant at Millers, Nev. The tank is built with the top flush with the ground line, or a few inches above it in order to prevent any drainage from running into it. The inside dimensions are 84 ft. 6 ins. long, 35 ft. wide and 8 ft. deep, the capacity being approximately 145,000 gallons or 4,700 barrels.

The walls of the tank are but 4 ins. thick, and it will be noted from the sketch that the sides and ends of the



CONCRETE TANK FOR FUEL OIL.

tank slope at an angle of 60° from the base. A rim around the upper periphery is 12 × 12 ins. In the mixing of the concrete great care was taken to prevent broken stone larger than ¾-in. from entering the mixture, in order that the seepage of the oil would be prevented. The mixture was 1 part cement, 1 part sand, and 1 part broken stone. Reinforcing bars were used only at the intersections of the angle corners. A suction pipe from the supply pump in the power-house connects at the base with a strainer, the tanks being filled direct from the railway tank cars.

A board cover prevents sand and debris from entering. There was plenty of concrete material at hand. Sand and rock cost practically nothing, so it will be seen to be very much cheaper than a steel tank.

T. B. Burnite,
Mechanical Engineer.

823 Lincoln Ave., Denver, Col., June 6, 1907.

Suits for Infringement of Patents on Bitulithic Pavements.

Sir: On page 592 in the issue of Engineering News of May 30, 1907, there appeared an article on "Tar Macadam Pavements in Duluth, Minn.," contributed by the Assistant City Engineer of that city. In view of the fact that this article nowhere advises the public that two suits are pending in the Federal Courts at Duluth against that city for infringing the patents owned by Warren Brothers Company, of Boston, Mass., and that two other suits are pending in the Federal Courts of Michigan against the cities of Owosso and Muskegon which have been argued and will soon be decided, we feel that the public should be advised against efforts to follow the example of Duluth in attempting to appropriate without paying therefor, the labor and property of others.

It is true that somewhere in the article reference is made to the fact that the city of Duluth lets this work by contract and requires the contractor to give a five-year guaranty bond to do the work, "furnish labor, plant and materials, and protect the city against suits for royalties"—an implication of consciousness that royalties are due to somebody—but no reference is made to the suits that are now pending against the cities of Duluth, Owosso and Muskegon, because of the infringement of patent rights.

When the circumstances under which the city of Duluth first undertook to lay a "tar macadam pavement," and at the same time endeavored to avoid infringing the patents of Warren Brothers Company, are fully explained and understood, the reason a bond is exacted "to protect the city against suits for royalties" will be perfectly clear.

In 1902 the city engineer of Duluth visited Boston as the guest of Warren Brothers Co. He was shown through their laboratory and works, and the theory of the bitulithic pavement, as then constructed and covered by patents, was fully explained to him. Appreciating the advantages of this method of street construction (which this engineer later as a witness for the Barber Asphalt Paving Co. in several suits, pending in Illinois, Iowa and Indiana, admitted was new and appealed to him), he recommended its adoption in Duluth, and a contract was awarded the Warren Brothers Co.

This city engineer carefully noted the method of construction followed by Warren Brothers Co. in Duluth and was afforded every opportunity to observe the manner of testing the materials used. The very next year, with the Warren patents before him and in consultation with the city solicitor for Duluth (facts brought out in testimony in the suits above referred to), this engineer undertook to prepare a set of specifications for a so-called "tar macadam pavement" that would produce the same results as the bitulithic construction, called for by the Warren patents, and at the same time not infringe the claims of these patents. These are the same specifications from which the assistant city engineer quotes in his article above referred to.

To point out the numerous palpable infringements, both of the method of construction and use of machinery, the patents upon which are owned exclusively by Warren Brothers Co., would extend this communication beyond all reasonable limits; but it is certainly due the public and city officials in general that they should know that suits are being prosecuted against the city of Duluth and others on account of these infringements.

Very truly yours,
Warren Brothers Company.

93 Federal St., Boston, Mass., June 18, 1907.

[In addition to the above communication, we have been furnished by the Warren Brothers Co. with a statement of the claims covered by their patents. We print this statement below. In accordance with our customary practice, also, we have submitted proof of the above letter and of the claims printed below to the author of the paper to which exception is taken—Mr. E. K. Coe, of Duluth. The Warren Bros. Co. statement reads as follows:—Ed.]

Two cases, involving the validity of the patents for street pavements owned by the Warren Brothers Co., were argued in the circuit court of the United States for the eastern district of Michigan before Judge Swan early in May and he now has these cases under advisement. The suits in each case were brought for adopting specifications and letting contracts for street pavements which, it was claimed, infringed the patents of Warren Brothers Co. The contracts in both cases were let and executed by the Barber Asphalt Paving Co., and these suits have been taken charge of and defended by that company for the cities named, under the terms of the bond which it gave to protect these cities against infringement. Two other suits against the city of Duluth for infringement of patents are also pending, but have not yet been heard, the plaintiff having taken the necessary proof to make out its prima facie case and being now waiting for the defendant to take its proof. In these cases the same attorneys are employed who represented the Barber Asphalt Paving Co. in the Owosso and Muskegon cases.

In the Owosso and Muskegon cases, as presented before

Judge Swan in a printed record of more than 1,800 pages in each case, the only question seriously argued was as to the validity of the claims of the patents sued upon—only two claims being involved in one case and four in the other.

As there appears to exist in the public mind, and in the minds of city engineers and officials, some misapprehension as to the scope of the Warren patents covering the street construction laid by them under the name "Bitulithic" it may be interesting to know at the present time just what is alleged to be covered by the patents in suit in the Owosso and Muskegon cases.

Mr. Fred. J. Warren, the original inventor and patentee of the bitulithic pavement, claimed that the addition made by him to the paving art, at the time his patents were issued, consisted in doing what had never before been attempted for the roadway of a street—that of mixing different sizes of stone for use in the wearing surface in such exact proportions that the spaces between the largest sizes of stone used would be filled by the use of stone of the next largest size that would fit in the voids, and so on down to an impalpable powder, thereby giving to the stone aggregate an inherent stability to withstand traffic independently of the cementing material used to coat the particles of stone and to fill the remaining voids in the mixture.

It is claimed that the application of these principles to the treatment of materials to be used in the wearing surface of a street pavement was new and patentable, and any specification which requires the use of different sizes of stone so graded, separated, proportioned and recombined before mixing as to produce this resultant stability in the mineral aggregate of the street pavement, independent of the cementing material used, is necessarily an infringement of the claims of the patents sued upon in these cases.

In other words, it is insisted not only that the principle as applied to a street pavement was new, but in the specifications accompanying the patent it was pointed out for the first time how this principle could be practically carried out in the preparation of the material and the actual construction of the pavement.

Of course, the claims of these patents could not be infringed in the construction of any kind of block pavement, whether wood, asphalt, brick or stone. The only other kinds of modern street pavement known at the time these patents were granted were ordinary macadam, tar macadam, and the standard sheet asphalt, and in none of these pavements were applied the principles used and called for by the Warren patents.

In the ordinary macadam pavement the different sizes of stone are used in layers on the street, the largest being on the bottom, and the finer on top.

In the ordinary tar macadam pavement the stone is coated with tar either before or after being spread on the street, and it is then laid and compressed as with ordinary macadam.

In the standard asphalt pavement, the 2-in. wearing surface is composed of 90% ordinary sand, none coarser than one-tenth of an inch in diameter, and 10% asphaltic cement; so that at the time of the issuance of these patents there is no pretense that any known form of street construction even approximated the claims set up in the Warren patents.

No one will pretend that inherent stability in the mineral aggregate can be produced by the use of no material larger than sand; and no one will claim that inherent stability could be produced by the use of different sizes of stone placed upon the street in layers, the larger being at the bottom and the smaller on top, as is done in the ordinary macadam construction. Inherent stability can be produced only by the intermingling of the different sizes of stone in the same mixture in such exact proportions that the voids between the larger sizes will be filled by use of the exact amount of the next smaller size that will fill these voids without pressing the larger stones apart.

It was upon the recognition of this principle and its application to the material to be used in the wearing surface of a street pavement that these patents claimed to be a new and useful invention never before applied to the paving art as it was then understood.

While it may be true that the principle was old, well recognized and thoroughly understood in its application to the building of a stone wall—that it was necessary to use the different sizes of stone "to break the joints" and to bridge over the joints between the larger sizes of stone—it was never imagined that this principle could be practically applied in the use of broken stone, running from an inch and one-half in size down to powder, in the construction of the two-inch wearing surface for a street pavement, until the inventor of bitulithic, by the exercise of creative faculty conceived the idea that this could be done and claimed a patent for a street pavement constructed out of small particles of broken stone put together on the same principle as that on which a solid stone wall is built.

The principle of the Warren patents covers the distinction, often overlooked, between solidity and stability. Solidity may be obtained by use of sand with an asphalt cement, but not necessarily stability; while stability may be obtained by the proper use of different sizes of stone and still the structure might lack a great deal of being solid. Sand, with water enough to fill the voids, will make a solid mixture which cannot be compressed without expelling the water. It will, however, by no means be a stable mixture; while stone of different sizes may be so placed as to have very great stability, though it would lack very much of being as solid as the sand and water.

To designate the kind of pavement construction under their patents, Warren Brothers Co. coined the word "Bitulithic" and have had it copyrighted and registered as their trade mark to designate one of the brands of cement used by them in the construction of the pavement, as well as the completed pavement itself. The bitulithic pavement has now come to be one of the recognized forms of modern city pavements, having been adopted in more than 150 cities extending from Glace Bay, Nova Scotia, to Portland, Oregon; and from Edmonton, Manitoba, to El Paso, Texas.

The foregoing briefly describes the fundamental or basic principles of the construction of the pavement laid under the Warren patents. It does not, however, fully cover the scope of those patents, of which there are twenty-six. These include essential patents for the detailed methods of construction, the necessary apparatus for controlling the sizes used in the combinations of varying proportions of stone, which, depending upon the local requirements, may range from one-half inch to two inches or more. The patents also cover the essential surface finish, commonly known as the flush coat, and also the stone chips.

[The reply received from Mr. Coe is as follows:—Ed.]

Sir: The writer is unable, after carefully reading the proof of Warren Bros. letter three times, and his own article once, to find any cause of controversy save one: The above communication accuses the fair City of Duluth of "appropriating without paying therefor the labor and property of others."

At this point the writer protests. Duluth is 21 miles long and one mile high and the Warren Bros. Co. is not small. If Duluth be jailed as a common thief, and retorts a la Roosevelt, both the jail and the Ananias Club will overflow. So please let's don't!

In your issue of May 30, the writer attempted to discuss, as an engineer for engineers, the tar macadam pavements of Duluth, incidentally giving the bitulithic pavement a dainty bit of free advertising.

He was aware, in a vague way, that some years ago the Warren Bros. Co. had begun proceedings against the City of Duluth, a few contractors, city officials, etc., but was not aware that the engineering profession in general was interested in the Court records of the U. S. Judicial Dist. for Northern Minnesota.

Now as to the clause regarding royalties: To the writer's personal knowledge, Warren Bros. Co. have had a copy of the specifications and contract for every tar macadam job in Duluth, and cannot find in one of them a demand for a bond to protect the city against suits for royalties. They do, however, like many other of the contracts, provide that "the price bid includes * * * (work in detail) * * * together with all materials, labor, tools and machinery, and also includes all royalties for the use of any and all patent rights made use of."

As to the charge of gross discourtesy implied against his honored friend and former chief, who was City Engineer in 1902, the writer is not called upon to speak; the gentleman is able to take care of himself.

Very respectfully,

Edward K. Coe, C. E.

Duluth, Minn., June 22, 1907.

THE INVENTION OF STEEL SKELETON CONSTRUCTION FOR BUILDINGS.

We briefly noted in our obituary column two weeks ago, the death of William Le Baron Jenney, a prominent Chicago architect and a member of the firm of Jenney, Mundie & Jensen, of 171 La Salle St. We are indebted to the firm for additional information concerning Mr. Jenney's career, with full statement of Mr. Jenney's work in connection with the introduction of steel skeleton construction for office buildings. We print it nearly in full, as follows:

In 1853 Mr. Jenney graduated from the Lawrence Scientific School of Harvard University, and in 1854 he entered the Ecole Centrale des Arts et Manufactures at Paris. Here his career was a brilliant one, and he received his diploma in 1856. During 1858 he again visited France, and remained a year and a half engaged in the study of architecture and art.

After the war, in 1868, he went to Chicago and began his professional career. His early works of note were Grace Episcopal Church, Wabash Ave. and 16th Street; the Portland Block, Washington and Dearborn Streets, built just after the fire, and the Mason Building.

It was Mr. Jenney who invented and made the application of the steel skeleton type of construction used universally in tall buildings. In the fall of he was appointed Architect for the Home Insu Company of New York City, and instructed to pr designs for a tall, fireproof office building to be lo on the northeast corner of Adams and La Salle st Chicago, and to be named "The Home Insurance Bu ing"; he was given further instructions that the above the second story should provide for the maxi number of well-lighted small offices. The instruc further stated that the building committee were aw that this would necessitate very small piers—sma probably, than were admissible if of ordinary mas construction, unless perhaps in the upper stories.

The architect was requested to report to the build committee the method of construction that would sat the requirements for stability and for small piers. naturally followed that if brick or stone were insuffici to carry the loads on the piers, a material must provided that would support a greater load per unit section. Architects had often been obliged to build a iron column into the masonry pier where the load wa exceptionally great. Mr. Jenney had done the sam thing, building iron columns into the small piers som years before. The natural solution of the problem wa to inclose an iron column within each of the smal masonry piers, thus satisfying the three requirements— small piers, strength and fireproofing.

The question of a column 150 feet high, under the extreme variation of temperature, say 100°F. or more from the hot sun in summer to the excessive cold in winter, now presented itself. A solution was soon found by Mr. Jenney, by supporting the walls and floors of each story independently on the columns, thus dividing the total movement into as many parts as there were stories, the expansion and contraction in no one story being of sufficient importance to require special consideration. The drawings were then prepared and the first design for a fireproof skeleton building was made and presented to the building committee of the Home Insurance Company for their acceptance. As business men, they naturally inquired "Where is there such a building?" The architect replied, "Your building at Chicago will be the first." This naturally suggested the company the very important question, "How do you know it is good?' The architect proposed to submit his designs and calculations to one or more bridge engineers of distinction, as the company might select, the design for the skeleton building resembling, in many respects, iron railroad bridges standing on end, side by side.

The columns in the Home Insurance Building were of cast-iron, the riveted columns of plates and angles being at that time thought too expensive. It was in this building that the first Bessemer steel beams were used, manufactured by the Carnegie-Phipps Co., who stated at the time that the Home Insurance Building was the first in the United States to use steel beams in its construction. It not only introduced the steel skeleton construction to the world, and was the first building in America to use steel beams in its construction, but it also added a long list to the requirements of a fine office building, such as wind bracing; thorough fireproofing; rapid running and safe elevator cars; light and well-ventilated rooms and corridors; fan-lights along the corridor side of the rooms, adding to the light of the corridor and to the ventilation of the rooms; an electric plant; provision of offices with tile vaults handsome in their appointments; and a system of plumbing of the highest modern type. All these appointments are now common to all good office buildings, but they were first used in the West in the Home Insurance Building; and many of them, like the metal elevator cars and the office vaults, were invented by Mr. Jenney for that building.

Among other prominent buildings built by Mr. Jenney while associated with Mr. Mundie are the Union League Club; the Horticultural Building at the Columbian Exposition; "The Fair" Department Store; Siegel, Cooper & Co.'s Store; the Association Building; the New York Life Building; the Chicago National Bank Building; the Trude Building, and the Fort Dearborn Building.

THE COST OF OPERATING AUTOMOBILE FIRE engines in Hanover, Germany, has been studied by former Consul-General Jay White, who secured the following table while stationed at Hanover.

Hanover was the first city to purchase a complete automobile fire-engine service, consisting of engines, hose carts and hook and ladder kit. The system is past the experimental state, as most of the apparatus has been in service now for a period of five years. A previous brief note of its operation and cost was made in our issue of June 1, 1905.

Cost Comparison of Horse and Automobile Fire Service.

	Horse.	Automobile.
First cost	$11,050	$13,000
Maintenance, first year	8,720	5,950
End of first year	19,750	19,000
Maintenance, next five years	43,500	29,850
Total	$63,250	$48,850

THE TWENTY-FOURTH ANNUAL CONVENTION OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

At the greatest electrical power center in the world—Niagara Falls, the members of the American Institute of Electrical Engineers assembled on Tuesday, June 25, for their twenty-fourth annual convention. The Cataract Hotel was selected as the convention headquarters, and the technical sessions were held there.

REGULAR SESSIONS.

With the President—Dr. Samuel Sheldon, of the Brooklyn Polytechnic Institute—in the chair, the first session was called to order on Tuesday morning at 9.45 o'clock. Mayor Douglas, of Niagara Falls, delivered an address of welcome, well filled with reminiscences of the time when, 15 years ago, he came to Niagara as a contractor and undertook the construction of the first canal and wheel-pit. He then described some of the methods resorted to in the construction of the tunnel and wheel-pit of the Electrical Development Co. of Ontario—the plant which discharges its waste water beneath the Horseshoe Fall—and some of the difficulties encountered in driving the tunnel through the rock formation back of the fall. He then outlined briefly a plan for the electrical illumination of the entire Falls by night:

"As a newly elected mayor always tries to give his people something new," said Mayor Douglas, "I have been trying to interest Niagara citizens in the illumination of the Falls." A resume of the plan submitted by the General Electric Co.—through Mr. W. D'A. Ryan, their illuminating expert—followed. It involved, briefly, two batteries of projectors; one of five, 60 ins., mounted at the highest point on the Canada side and so placed as to catch the crest of the Falls and to sweep the Canadian rapids; the other of 25 smaller projectors to be placed in a crescent at the base of the gorge on the Canada side. Both batteries are planned with color attachments, and side issues such as smoke-bomb mortars and "scintillator heads" are to be provided—the whole to allow a sort of continuous performance, regardless of the phase of the moon.

President Sheldon responded to the Mayor on behalf of the Institute, and then delivered his presidential address—a paper on "The Properties of Electrons." The introductory remarks to this paper were these:

> The physical properties of electrons form the basis of electrical engineering, and a thorough understanding of them is essential for successful investigation in some departments of research. No specific treatment of the subject has appeared in the printed publications of the institute. It is therefore hoped that what follows will be of service to the membership. No attempt has been made to treat of the conduction of electricity through gases, of the phenomena of radio-activity, nor of electrolytic conduction, in all of which the electron plays an important part.

A masterly and logical exposition of the subject followed.

The next paper in order was "The Heating of Copper Wires by Electric Currents," by Dr. A. E. Kennelly and E. R. Shepard. In the absence of the authors this paper was read by title. Prof. Morgan Brooks, of the Chair of Electrical Engineering at the University of Illinois, presented "Interaction of Synchronous Machines," and Mr. Henry W. Fisher, of the Standard Underground Cable Co., Pittsburg, "Power Factor, Alternating Current Inductive Capacity, Chemical and Other Tests of Rubber-Covered Wires of Different Manufacturers."

Discussion was not very active at this first session. Less than one-half of the ultimate total of delegates had arrived at the time, and between that fact and the inordinately hot weather things had not entirely "loosened up."

The next regular session was called to order at 8 o'clock Tuesday evening, and was devoted entirely to the subject of protective apparatus for power lines and plants. Mr. E. E. F. Creighton, Assistant Professor of Electrical Engineering, Union College, Schenectady, opened with a paper on "Protective Apparatus Engineering"; Mr. Percy H. Thomas, of the Cooper-Hewitt Electric Co., New York, presented "Practical Testing of Commercial Lightning Arresters," and Mr. N. J. Neall, Consulting Electrical Engineer, of Boston, "A Proposed Lightning Arrester Test." Prof. Creighton's paper outlined the present ordinary test for arresters, some newer tests, and the general conditions met with in the design and installation of protective apparatus. Mr. Thomas's paper was substantially along the same lines, and looked to the adoption of standard arrester tests as a part of the standardization rules of the Institute; an abstract of the suggested recommendations will be made in an early issue of Engineering News. Mr. Neall's paper completed the protective series and the papers were thrown open to discussion. Most of the discussion was among the writers of the papers; Dr. Chas. P. Steinmetz contributed actively thereto—most of what was said being in the direction of a standardization of present testing methods, and of framing up such standardization for general practice.

The paper on "Inductive Disturbances in Telephone Lines," by Mr. Louis Cohen, was in the absence of its author read by title, and, there being no discussion, the meeting was adjourned.

Wednesday morning at 9.45 the third session was opened by the presentation of a paper on "Choke Coils versus Extra Insulation on End Windings of Transformers" by Mr. S. M. Kintner, Electrical Engineer with the Westinghouse Electric & Mfg. Co.; Mr. Walter S. Moody, Designing Engineer with the General Electric Co., read a paper along kindred lines—"Protection of the Internal Insulation of a Static Transformer against High Frequency Strains"; and Mr. H. W. Tobey, Engineer with the Stanley G. I. Elec. Mfg. Co., presented "Notes on Transformer Testing." The three papers were then thrown open to discussion, and created much animated argument. The questions "Choke coils or not," and "if choke coils, where?" received the attention of leading engineers. Dr. Steinmetz was moved to propound his somewhat famous conundrum, "When is a choke coil not a choke coil?"—answer, "When it does not choke;" he emphasized the fact that the choke coil must be the first piece of apparatus on a transmission line, and, by its impedance, must keep sudden oscillatory strains, from lightning discharge, from the transformers until the arresters may operate. He also seemed to favor the interior of the transformer case as a location for the choke coil, although calling attention to the fact that it must be more carefully insulated than the transformer itself. Air insulation being easy, he suggested the poles outside the power-house as a convenient place of mounting. Messrs. A. H. Pikler (Crocker-Wheeler Elec. Co.), K. C. Randall (Westinghouse), D. B. Rushmore (G. E.), P. M. Lincoln (Westinghouse), J. W. Fraser (Southern Power Co., Asheville, N. C.), W. N. Smith (West., Church, Kerr & Co.), Prof. Creighton, Chas. W. Stone (G. E.), Wm. McClellan (W. C. K. & Co.), Prof. Morgan Brooks (U. of Ill.), Ralph D. Mershon, and others all contributed educating discussion on the choke coil question. On the whole the majority of opinion seemed to be in favor of the use of choke coils—cheaper to replace, if burnt up, than transformers—and of mounting them outside the transformer case, even out-of-doors on poles. Mr. Harold W. Buck expressed as his opinion that conditions were so variable that the use of choke coils may not at present be endorsed nor condemned with due propriety.

Mr. D. R. Scholes briefly abstracted his paper on "Transmission-Line Towers and Economical Spans"; and in the absence of Mr. Norman Rowe, Gen. Supt. Guanajuato Power & Electric Co., Mexico, his paper on "Lightning Rods and Grounded Cables as a Means of Protecting Transmission Lines against Lightning" was read by Ralph D. Mershon. The first of these was chiefly concerned with details of design; the second treated of some experiences of the Guanajuato P. & E. Co. before and after installing lightning rods on their towers and a grounded cable above the triangle of power cables.

Both of these created considerable discussion. As to Mr. Scholes' paper, Mr. W. S. Lee (Chief Eng. Southern Power Co., Asheville) advocated variable spans to suit the profile of the country traversed by the line, having a standard tower strong enough for the larger spans and using it as well for the shorter ones.

Mr. Mershon, in regard to the use of grounded overhead cables as a protection, cited examples which, he maintained, proved that lightning did not travel along a conductor; he said that in one instance a bolt punctured an insulator and traveled thence to ground rather than travel 500 ft. along a line to jump a 6-in. gap to ground. The general trend of the discussion was against the use of grounded cables overhead as a protective medium.

Mr. D. R. Scholes, with a few brief replies to questions put to him in the course of the discussion, closed this session.

The first paper for the fourth session, Wednesday evening, was one by Mr. Ralph D. Mershon descriptive of the transmission plant of the Niagara, Lockport & Ontario Power Co. This plant is the most comprehensive in its present and projected scope of all of those at the Falls, and the paper correspondingly interesting; the company expects within two years to be transmitting 60,000 HP., and its present right-of-way purchases are with reference to an ultimate transmission of 180,000 HP. The company is a transmission company only, buying its power to be transmitted and having no generating plant of its own. Mr. Mershon having left through necessity before this session was called, the paper was read by Mr. F. B. H. Paine, of the Iroquois Construction Co., Buffalo.

"Location of Broken Insulators and Other Transmission-Line Troubles" was presented by Mr. L. C. Nicholson, of the Iroquois Construction Co.; this paper described some efficient and accurate testing methods for central station use.

Messrs. E. M. Hewlett, Engineer with the General Electric Co., and Harold W. Buck, Consulting Engineer, of 49 Wall St., New York, presented two papers closely interlinked—"A New Type of Insulator for High Tension Transmission Lines" and "Some New Methods in High-Tension Line Construction." These papers mark somewhat of a departure from the conventional pin-and-petticoat insulator construction. In the discussion of these papers Mr. D. B. Rushmore (G. E. Co.) commended Mr. Hewlett's insulator in that it required, in its mounting, such a small amount of metal, thus tending to reduce static capacity. Mr. Wm. McClellan asked regarding the cost of such an insulator compared to the pin type; Mr. Hewlett replied that it sold, in the size described, at $1.50 per disk—allowing two to three disks in series for insulating a 60,000 volt line, depending on the safety factor desired. Mr. Hewlett, in his closing remarks, described a test which he had made on four of his disks in series, in which he had run the voltage up to 380,000 without any sparking over—the insulators being dry.

Mr. Stephen Q. Hayes, switchboard engineer of the Westinghouse Electric & Manufacturing Co., presented at this session a paper on "Switchboard Practice for Voltages of 60,000 and Upward." Perhaps the best point brought out in this paper was the advocating of open wiring about the station, for reasons of safety to attendants, accessibility, etc.

At the session held Thursday morning, June 27, the first paper presented was by Mr. E. G. Acheson, President of the International Acheson Graphite Co. of Niagara Falls, on "Deflocculated Graphite." Mr. Acheson's paper, presented in conjunction with experiments performed before the meeting, brought out some rather startling departures in lubrication in the shape of graphite held indefinitely in suspension in water by the addition of gallotannic acid and ammonia. He discovered this property of graphite, he stated, in conjunction with electrical work—hence his presentation of the subject at the convention. In order not to depart too radically from time-honored practices in lubrication, Mr. Acheson has worked towards the indefinite retention in suspension of graphite in oil; he showed samples of kerosene and spindle oil in which he had, chemically, succeeded in maintaining indefinite suspension of about 0.5% of graphite.

Mr. A. H. Armstrong, of the General Electric Co., presented "Single-Phase vs. Three-Phase Generators for Single-Phase Railways," a paper prepared with the purpose of inducing free discussion between manufacturers and users, giving experiences which will help to bring about general conclusions on the subject. The merits of both the generation of single-phase current and that of three-phase current with the use of a single leg for the railway load were set forth; and as they both seem to offer advantages justifying their recommendation, the paper in closing advised the leaving of the choice to the needs of local requirements.

The next two papers covered the frequency question. Mr. Armstrong presented the first, "The Choice of Frequency for Single-Phase Alternating-Current Motors," and Mr. N. W. Storer, of the Westinghouse E. & M. Co., the second, "Twenty-five vs. Fifteen Cycles for Heavy Railway Service." When these two were opened for discussion the arguments for and against the adoption of an additional frequency to the existing 60 and 25 cycles were numerous and interesting.

While the addition of another standard frequency—15 cycle—to the existing ones was discussed with due conservatism (Dr. Steinmetz remarking that the ghosts of abandoned frequencies still haunt the profession) the general trend of opinion was that, since it has been proven by comparative test that with 15 cycles one third more drawbar pull could be obtained than with 25, and as railways are going to buy motive power for drawbar pull, regardless of what frequency power companies would rather maintain, the adoption of 15 cycles was advisable—or even a lower frequency if it proved more efficient in traction work. Many interesting sidelights in electric railway development were introduced into the discussion of this subject.

Thursday afternoon, after an interpolated paper by Mr. E. H. Anderson (G. E. Co.) on "Commutating Pole Direct-Current Railway Motors," the entire session was devoted to educational, ethical and standardization matters.

Two educational papers—"The Attitude of the Technical Schools towards the Profession of Electrical Engineering," by Prof. H. H. Norris, of the Chair of Electrical Engineering at Cornell University, and "The Concentric Method of Teaching Electrical Engineering," by Vladimir Karapetoff, Assistant Professor of Experimental Engineering at Cornell—opened up a mine of discussion, by both teaching and practicing engineers, which it is our regret to be unable to present, owing to limitations of space.

The outcome of the presentation of these two papers—radically different in the methods exploited, Prof. Karapetoff's being somewhat startling in its departures from current educational methods (though, it is admitted, more or less logical in some of its reversals of the old order of instruction)—and of the discussion that followed their reading, was that a vote was passed to appoint an Institute Committee on educational matters.

Dr. Schuyler Skaats Wheeler, President of the Crocker-Wheeler Electric Co., as Chairman of the Committee on a Code of Professional Ethics, read the report of the committee—which included a code of ethical rules for the guidance of the members of the Institute. After discussion, which waxed somewhat hot at times, the subject being a somewhat delicate one—the report of the committee, and the rules therein, were adopted. Later, however, on a point of order this action was declared void and the subject was referred back.

The Standardization Rules of the Institut., as revised to June 7, 1907, were endorsed as approved by the Board of Directors, and the session was adjourned.

Friday morning, after the opening of the session by the President, Vice-President Townsend Wolcott took the chair. The following papers were presented at this session: "Regeneration of Power with Single-Phase Electric Railway Motors," by William Cooper, Consulting Engineer of Wilkinsburg, Pa.; "Fractional Pitch Windings for Induction Motors and Alternators," by Prof. C. A. Adams (Chair of Electrical Engineering, Harvard), W. K. Cabot and G. Æ. Irving, Jr.; "The Vector Diagram of the Compensated Single-Phase Alternating-Current Motor," by W. I. Slichter; and "Zigzag Leakage of Induction Motors," by R. E. Hellmund, Designing Engineer at the Western Electric Company's Hawthorne plant.

At Friday's afternoon session—the closing session of the convention, with President Sheldon in the chair—Mr. L. F. Howard, Assistant Electrical Engineer of the Union Switch & Signal Co. of Pittsburg, presented "Track Circuit Signaling on Electrified Roads." This "live" topic was well presented, and heard with interest by the delegates; descriptions were given of the systems on the New York Subway, the Boston Subway and Elevated, and several other surface and elevated roads. In the discussion which followed, attention was called by Messrs. Chas. F. Scott (West. E. & M. Co.) and President Elect H. G. Stott (Supt. Motive Power, Int. Rapid Trans. Co., New York.) to the place held by the signal engineer in the profession to-day, and its importance in railway development.

Mr. F. G. Baum (Cons. Engr., San Francisco) being absent, his paper on "Some Power Transmission Economics" was read by title. In the discussion by Dr. Steinmetz and Mr. F. B. H. Paine, attention was called to some Western practices in power-line installation that would not be sanctioned in the Eastern section of the country.

"One-Phase High-Tension Power Transmission," by Mr. E. J. Young—Electrician for the Michigan Lake Superior Power Co.—was also, in the absence of its author, presented by title, and underwent brief discussion by Dr. Steinmetz and Mr. C. F. Scott.

ENTERTAINMENT.

The local committee made ample arrangements for the social and recreational side of the convention. Tuesday afternoon was devoted to a trolley trip down Niagara Gorge and back by the Great Gorge Route. On Wednesday afternoon there was held an afternoon tea at the conservatory of the Natural Food Company—of Shredded Wheat Biscuit fame. During the technical session on Thursday morning the ladies were treated to an automobile tour; and the same evening a reception was held at the Cataract House, followed by dancing.

On Friday evening those that were left—by no means many—were tendered a searchlight trolley trip down the gorge to the Whirlpool Rapids, which included a stop of a half hour while different colored searchlights were played upon the rapids.

ATTENDANCE.

The total registration was 459. Up to noon of the opening day it numbered but 244—that number including the local reception committee of nearly 100 members; Wednesday swelled the number to 383, and Thursday to 431.

Considering the total membership of the Institute, 4,200, the number present at the convention seems small; but the wide scattering of the membership through this country and the world at large accounts for that.

Twenty states of the Union, and the District of Columbia, were represented. Six foreign countries or provinces were also represented. From our own country the range of attendance was from Massachusetts on the east to Washington on the west; and from the Northern Peninsula of Michigan to North Carolina on the south. Calcutta, India, was the most distant point represented.

NOTES FROM ENGINEERING SCHOOLS.

WORCESTER POLYTECHNIC INSTITUTE.—The new electrical engineering building was dedicated June 13. The value of the building and equipment is placed at $250,000.

TULANE UNIVERSITY.—At the opening of the session of 1907-08 there will be offered in the College of Technology a course in acrhitecture, extending like other regular courses over four years and leading to a degree. In addition to the required subjects to be taken un the present Faculty, the special architectura ubjects will be taught by specialists, as f ws: Samuel S. Labouisse, B. E. (Tulane), B. in Architecture (Columbia), formerly stud in Rome and Paris; Moise H. Goldstein, E. (Tulane), B. S. in Architecture (Mass. In te Tech.), formerly student in Europe; and rof. William Woodward, of the College of Art nd Sciences. Lectures will be given durin the course by local architects on practical su cts bearing upon the work of the professors.

The requirements for admission will be the same as those for other courses in the C ege of Technology, and no student will be admitted as "special" who is under twenty years of age.

THE EXPLOSION OF A LARGE STEEL CYLINDER under a steam pressure of 120 lbs. per sq. in. caused the death of three persons on June 20. This cylinder at the plant of the Schenectady Sand Lime Brick Co., Schenectady, N. Y., was opened by mistake without removing the steam pressure. The cylinder head went in one direction, killing two workmen and wrecking a steel water tower, tank and windmill. The cylinder itself, about 5 ft. in diameter and some 40 ft. long, went through the end of the building, killed a section hand on the Delaware & Hudson tracks and finally stopped about 500 ft. from its original location.

THE EXPLOSION OF 50 LBS. OF DYNAMITE in a deep cut on the Tidewater Railway, near Tola, Va., June 25, killed eight men and injured six. The cause of the premature explosion is unknown.

A TENEMENT BUILDING under repairs collapsed in New York City on June 25th and seven persons were killed and many others injured. The building had been condemned by the building department of the city and certain alterations to ensure its safety were being carried on under the almost constant inspection of the city officials. The accident occurred some two hours after a city inspector's favorable report as to the safety of the operations.

IN A COLLISION ON THE PENNSYLVANIA RAILroad, June 27, near Cynwyd, a Philadelphia suburban station, between an accommodation passenger train and a freight locomotive, the engineer of the passenger train was killed and several passengers were injured. The freight engine, with a caboose, was proceeding in the same direction as the passenger on a parallel track, when it ran into an open switch entering the track of the passenger train. The locomotive of the latter was turned over on its side. According to newspaper reports, the blame is placed with the crew of the freight.

PUBLICITY OF ACCIDENT INQUIRIES by railways is the subject of an order issued by the management of the Union Pacific and Southern Pacific systems. The order directs that hereafter full reports shall be made promptly and given to the press concerning all accidents on the lines of these systems. It recites a statement of the Interstate Commerce Commission that of the serious accidents which occurred during the last five years, 70% were caused by negligence of trainmen. Making public all determinable facts about the circumstances of train wrecks is thought to be an excellent means for securing better discipline of employees. This view was publicly expressed a few months ago by Mr. J. Kruttschnitt, Vice-President of the Southern Pacific Co., at a time when few railway men held, or at least publicly avowed, such opinions. At present several large railway systems have announced such a policy of publicity in the matter of accidents. The action of the Pennsylvania R. R. in making public its expert committee's report on the derailment at Mineral Point, near Johnstown, Pa., was one of the first moves in this direction.

THE STEEL RAIL QUESTION led to a conference a week ago at the New York office of the U. S. Steel Corporation, in which high officers of leading railway lines and representatives of rail manufacturers discussed ways and means for improving rails. It was decided to await the report of the American Railway Associations' special committee, and to consider the subject at a later meeting on the basis of this report. The official statement issued after the conference stated that the meeting was entirely harmonious and friendly. About the same time press reports from Pittsburg said that rail manufacturers were asking an increase of $5 per ton (from $28 to $33) for rolling rails to stricter specification.

WORK ON THE MANHATTAN BRIDGE across the East River at New York City has reached the point where erection of the superstructure has been begun. On June 26 erection was started with the setting of tower shoes at the Manhattan tower. The Ryan-Parker Construction Co. has the contract for the superstructure.

AN EXPOSITION IN LONDON is officially announced for the summer of 1908, to include science, art, products, manufactures, and systems of education of the whole British Empire, together with those of France and all her colonies. The preliminary arrangements were made last November between the officials of the governments named and a site for the exhibition agreed upon. Detailed information may be obtained from the Secretary of the exhibition, 56 Victoria St., Westminster, S. W. London, England.

THE RAISING OF THE ASSOUAN DAM across the Nile promises to give a great impetus to agricultural and engineering projects in Egypt. It is proposed within the next few years to raise this dam so as to supply enough water to irrigate about 1,000,000 additional acres of land, in the development of which many correlated schemes for sanitation, water supply and railway construction will be investigated.

THE RECLAMATION OF ANCIENT BABYLONIAN territory is advocated by Sir William Willcocks, K. C. M. G., M. Inst. C. E., of Cairo, Egypt, formerly Director-General of Reservoirs of Egypt.

In ancient times the greater portion of the country between the Tigris River and the mountains of Persia and Kurdistan were artificially irrigated and held the granaries of the world. The grain fields on these alluvial plains so excited the wonder of the Greek travellers that it was reflected in their writings.

When the Chaldeans settled about the delta of the Tigris and the Euphrates they built great irrigation works and made the desert a garden. It was in this district that the original wild wheat became cultivated, and from here was transplanted to all the civilized world.

The land was protected from floods, and watered in droughts, by an enormous system of canals and dikes, which cover the face of the country even to-day. The work of the ancients went to ruin while the people were so completely engaged in war that repairs could not be kept up. The swollen Tigris broke its barriers and destroyed the cities of the plains. From then to now the desert has remained untouched about the birthplace of civilization.

The plans of Sir William Willcocks would make this territory again a great grain country. The plans are as feasible as the work he successfully carried out on the River Nile, whose waters carry a smaller percentage of fertilizing silt than the Tigris. The two principal projects are estimated to cost seventeen and twenty million dollars, with a probable income of 15 to 20% on the outlay. Bagdad is the centre of the area proposed for reclamation. In this area the rainfall is only about three or four inches each year.

ANOTHER LONDON "TUBE" LINE was opened for traffic on June 22. This is the Charing Cross, Euston & Hampstead Ry., connecting the Charing Cross terminal of the Southeastern & Chatham Ry. with the Euston terminal of the London & Northwestern Ry., and extending thence north to residence districts. It is owned by the London Underground Ry. Co., which also owns the Baker St. & Waterloo Ry. and the Great Northern, Piccadilly & Brompton Ry., the latter of which was opened for traffic six months ago. A map showing the London transit lines may be found in our issue of March 21, 1907, p. 316. The Charing Cross, Euston & Hampstead Ry. is about eight miles long, and cost about $25,000,000.

AN UNUSUAL DIFFICULTY in tunneling was met with in a short section of the Tauern tunnel, in Austria, now nearly completed. In the section in question it frequently happened that, after a blast had been set off, rock at the face of the heading split or burst off in a large block or plate, with considerable force and accompanied by an explosion-like noise. The phenomenon seemed to be due to stresses in the rock. It subjected the muckers to great danger, as the splitting out and falling of the rock was liable to occur just when a large force of muckers was concentrated at the face to clear away for the drill tracks prior to resumption of drilling. The Tauern tunnel is to have a length between portals of 27,965 ft., about 5.3 miles.

THE TUNIS MONORAIL RAILWAY SYSTEM, which is on exhibition at the Jamestown Exposition, is proposed for installation on a four-track elevated railway to be built between Jersey City and Newark. Among those interested in the company to build the new system are Messrs. John H. Starin, Charles Stewart Smith and Woodbury Langdon, members of the New York Rapid Transit Commission, which ceased to exist on July 1. The Tunis system resembles the system exploited by E. Moody Boynton some fifteen years ago.

THE TOTAL ESTIMATED PRODUCTION OF THE mining district in Montana known as the Philipsburg Quadrangle is provisionally placed at from $45,000,000 to $50,000,000.

The Philipsburg Quadrangle is a 30' area which joins the south half of the Helena 60' Quadrangle on the west. It is mountainous, with elevations ranging between 4,600 and 10,600 ft., the central portion being drained by Flint Creek. This amount, over $32,000,000 in gold and silver, from which nearly $15,000,000 has been paid in dividends, is the record of two mines, only: the Granite Mountain and Bimetallic. These two mines lie about 2½ miles southeast of Philipsburg, on the western slope of Granite Mountain, and 3,000 ft. above Flint Creek valley. Although located on the same ore shoot and controlled from the earliest days by practically the same interests, the mines were worked separately until 1878, when a consolidation was effected. Since that time they have been substantially operated as one mine.

RAPID CAR DUMPING records are reported as made by a new McMyler car dumping machine recently erected at the Hanna docks in Sandusky, Ohio. On a recent run, 80 cars were dumped in five hours, an average of a little over four minutes per car for the entire time. The machine was built by the Riverside Bridge Co., of Martin's Ferry, Ohio.

COAL MINING WITH A PUMP DREDGE is practiced on the Susquehanna River. There are in the bed of the river large deposits of coal which are washed down from the piles of coal and culm along the upper river, and the recovery of this is regularly carried on by a pumping and dredging method. It is said that as much as 25,000 tons are recovered from the river bed each year.

Under the circumstances the coal recovered in this manner has been well washed and protected from the action of the air. It is found in the river usually behind sand bars and, in fact, in almost any place where eddies are formed.

The pump used for this work is an ordinary pan pump driven by a portable engine on a scow. It discharges upon a ⅝-in. square mesh screen, which allows water and sand to pass back to the river. The coal, after being cleaned of rock, etc., is discharged into flatboats and delivered for use.

THE EARNINGS OF MINING SCHOOL GRADUATES have been shown in statistics collected for the mining and metallurgical courses of Lawrence Scientific School. The average earnings of 25 men for the first year were $878, for the second $1,456, and in the third $1,900. The average present age of graduates is 28 years, and the average present salary is $2,387.

THE SPREAD OF PATHOGENIC BACTERIA through air from sewers has been experimented on at some length by Major W. H. Horrocks. From a summary of a paper by Major Horrocks, published in the Journal of the Royal Sanitary Institute (London) for May, 1907, we take the following conclusions:

(1) Specific bacteria present in sewage may be ejected into the air of ventilation pipes, inspection chambers, drains and sewers by (a) the bursting of bubbles at the surface of the sewage, (b) the separation of dried particles from the walls of pipes, chambers and sewers, and probably by (c) the ejection of minute droplets from flowing sewage.

(2) A disconnecting trap undoubtedly prevents the passage of bacteria, present in the air of a sewer, into the house drainage system.

(3) An air inlet, even when provided with a mica valve, may be a source of danger when it is placed at or about the ground level.

It may be explained that by a disconnecting trap is meant, in addition to what is known in America as a running or main trap, a chamber connected with the outer air, to break the continuity of flow of sewage in the house sewer.

A TESTER FOR TROLLEY-WIRE SUPPORTS is in use in England, which is used to detect leakage from the supported wires through to ground. The regulations of the British Board of Trade specify that each insulator supporting overhead conductors for electric railways shall be tested not less often than once a month, defective insulators being immediately removed and efficient ones substituted.

Owing to the fact that two instruments are in use in series at each testing point, the daily test of the entire line from the central station does not give sufficient means for detecting faults in the overhead insulation. It would be a tedious proposition to test each insulator separately with a pole and contact, or from a tower wagon.

The tester in question has been designed for application to the trolley pole of a testing car, and affords a rapid means of detecting faulty insulators. It consists of a light aluminum frame which is clamped at the top of the trolley pole and carries a wooden cross-arm pivoted at the center. At each end of this cross-arm is a light bow or spring, and as the wheel passes under the span wire each of these springs makes momentary rubbing contact against the under side of the span wire. There is a device which operates automatically to keep the cross-bar always at right angles to the trolley wire, regardless of the position of the trolley pole.

In operation the device is used in connection with a moving coil volt-meter scaled to 600 volts. It will be readily understood how the connections may be arranged so that when a faulty insulator is struck and the span wire found to be electrified, the volt-meter will show a deflection at the instant of contact. The sensitiveness of the volt-meter may be increased by pressing a key wired for that purpose, and the meter is also arranged with a direct reading insulation scale with a range of 10 megohms.

During the test the car is run at about seven miles per hour, so that it requires but a short time to test the overhead insulation of the entire system.

THE CORBETT TUNNELL, Shoshone Irrigation Project of the U. S. Geological Survey, Wyoming, was completed on June 21. Excavation was begun on Jan. 14, 1906. The contractors having failed to carry out the work satisfactorily, the Government took over the work on Aug. 9, 1906. The tunnel is 10 × 10 ft. in cross-section and 3½ miles in length. Water impounded by the Shoshone dam will be conducted down the natural channel of the Shoshone River 16 miles, and then diverted through the above-named tunnel out upon the land to be irrigated. The tunnel has a carrying capacity of 2,000 acre-ft. per day of 24 hours. It is expected that the lining of the tunnel will be completed by Sept. 1.

PERSONALS.

Mr. Henry G. Bradlee has become a partner with C. A. Stone, Edwin S. Webster and Russell Robb, in the firm of Stone & Webster, Boston, Mass.

Mr. Edgar French, formerly of the firm of French & Russell, has opened an office for the practice of civil engineering at 938 Majestic Building, Detroit, Mich.

Mr. H. R. Safford, Assistant Chief Engineer of the Illinois Central Ry., has been appointed Chief Engineer of Maintenance of Way, and the former position has been abolished.

Mr. B. S. Joselyn, Vice-President of the Maryland Telephone Co., of Baltimore, has resigned to accept the presidency of the Portland Railway, Light & Power Co., of Portland, Ore.

Mr. H. A. Paine, Assoc. M. Am. Soc. C. E., who has been for the past seven years in charge of the location of railways throughout the South and Southwest, will spend the summer at his home in Odessa, N. Y.

Mr. William L. Derr has been appointed general superintendent of the New York City Street Railway Co., to take office July 1. Since February, 1907, he has been Superintendent of the Chicago & Alton R. R., at Bloomington, Ill.

Mr. H. B. Earling, Assistant General Superintendent of the Chicago, Milwaukee & St. Paul Railway, has become General Superintendent of the Pacific Coast extension covering 1,500 miles. Mr. Earling will have headquarters at Butte, Montana.

Mr. W. E. Wheeler, formerly Resident Engineer of the Erie and Jersey R. R., Assistant Engineer on the Pensacola, Alabama and Western R. R., has resigned the latter position to resume the work on the Erie and Jersey R. R., at Central Valley, N. Y.

Mr. J. C. Wilder has resigned as Superintendent of the Coast Division of the Southern Pacific Ry., to take effect July 1. W. A. McGovern, Superintendent of the Tucson Division, will fill the vacancy. The new Superintendent of the Tucson Division will be W. H. Averill, Assistant Superintendent at Bakersfield.

Mr. Charles E. Hubbell, formerly Vice-President and General Manager of the Syracuse and Suburban R. R. Co., has been elected President of that company, to fill the vacancy made by the death of John L. King. Mr. Chester H. King, son of the late John L. King, succeeds Mr. Hubbell as Vice-President.

Mr. H. P. Adair, C. E., of Boise, Idaho, is now Chief Engineer for the Lost River Land & Irrigation Co., which has under way a large project, under the provisions of the Carey Act, for the irrigation of 80,000 acres in the valley of Lost River, Idaho. E. B. Darlington, C. E., of Boise, is Principal Assistant Engineer.

Major W. W. Harts, Corps of Engineers, U. S. A., Mem. Am. Soc. C. E., has been appointed superintending engineer of river work for the Tennessee and Cumberland Rivers. Major Harts has been a member of the California Debris Commission, Engineer in charge of work on the Sacramento and San Joaquin Rivers in California, and in charge of the construction of locks, dams and canals on the Columbia River.

Mr. O. H. Gentner, Jr., of Philadelphia, has been engaged as Assistant Engineer in charge of estimating and drafting in the Reinforced Concrete Department by the General Fireproofing Company and will make his headquarters at Youngstown. Mr. Gentner has been with J. A. Patterson, Consulting Engineer on structural work; with G. W. & W. D. Hewitt, and Ballenger & Perrot, Architects, Philadelphia, on concrete construction and structural work; and with the Unit Concrete Steel Frame Company, Tucker & Vinton, and the Vulcanite Paving Company, in charge of reinforced concrete work.

Mr. E. J. McCaustland, Mem. Am. Soc. C. E., Mem. Am. Inst. M. E., has been appointed Professor of Mining Engineering in the University of Alabama. Professor McCaustland has been for the last five years Assistant Professor of Mining and Surveying in Cornell University, in charge of the laboratories for testing materials of the College of Civil Engineering. He is a member of the Society for the Promotion of Engineering Education, and a Fellow of the American Association for the Advancement of Science. He has had wide experience in the mining regions of California, Oregon, Montana and Pennsylvania.

Mr. Matthias N. Forney, M. Am. Soc. M. E., was married on June 25 at Baltimore, Md., to Mrs. Annie Virginia Spear. The bride's first husband, P. Forney Spear, who died some years ago, was a cousin of Mr. Forney's. Mr. Forney was mechanical editor of the "Railroad Gazette" and one of the principal owners of the publication in the early '80s, and during that time he wrote his "Catechism of the Locomotive," which has had a sale equaled by few books on mechanical subjects. After disposing of his interest in the "Railroad Gazette" in 1887, Mr. Forney conducted "The American Engineer & Railroad Journal" for several years.

A large elevator dredge to be used in enlarging the water power canal at Massena, N. Y., for the Aluminum Co. of America has been named after the late Capt. Alfred E. Hunt, who died in 1898, as a result of disease contracted in the Porto Rico campaign. Capt. Hunt was one of the founders of the Pittsburg Reduction Company, which in the early '90s exploited the Hall process of aluminum production and first brought the metal into commercial use on a large scale. He also stood among the foremost of engineers engaged in the testing of materials, and his remarkable personality won him a host of friends throughout the profession.

Messrs. Julius H. Gillis and S. Ward Haas have recently opened an engineering office at 530 Metropolitan Life Building, Minneapolis, Minn., under the firm name of Gillis-Haas Co. Mr. Haas, who is a graduate of the Civil Engineering course of Cornell University, has been in the employ of the Pencoyd Iron Works, the Phoenix Bridge Co., the Canadian Bridge Co., and the Minneapolis Steel & Machinery Co. Mr. Gillis has been connected with the engineering department of several railroads in the Middle West, including the Minneapolis, St. Paul & Sault Ste. Marie Ry. and the Wisconsin Central Ry. He was lately in charge of the mill building squad of the Minneapolis Steel & Machinery Co. The specialty of the firm will be steel buildings and bridges.

Maj. Harry F. Hodges, M. Am. Soc. C. E., of the Engineer Corps, U. S. A., has been appointed by the Secretary of War, Purchasing Agent of the Isthmian Canal Commission, with headquarters in Washington, D. C. He will have general charge of all contracts for the material and work of the Panama project. Maj. Hodges is a graduate of the Military Academy, Class of 1881. He was at one time on the faculty of the academy in the department of civil engineering. He has been identified with large river and harbor projects in this country, including those of the upper Missouri and in Ohio, West Virginia and Kentucky. In 1898 he was in Porto Rico, on roads and defenses, and later was Colonel of the First U. S. Volunteer Engineers. He was chief engineer officer on the staff of Gen. Leonard Wood in the department of Cuba. Maj. Hodges is the author of several professional papers, among them being "Notes on Mitering Lock Gates," published by the War Department.

The members of the Public Service Commissions of New York have been appointed by Gov. Hughes, as follows:

For the First District (New York, Kings, Queens and Richmond counties), Messrs. W. R. Willcox, of New York City; Wm. McCarroll, of Brooklyn; E. M. Bassett, of Brooklyn; M. R. Maltbie, of New York City; J. E. Eustis, of Bronx Borough.

For the Second District (all other counties of the state), F. W. Stevens, of Jamestown, C. H. Keep, of Buffalo; T. M. Osborne, of Auburn; J. E. Sague, Mem. Am. Soc. M. E., of New Hamburg; M. S. Decker, of New Paltz.

Mr. W. R. Willcox was born in Smyrna, N. Y., in 1863. He was educated at the University of Rochester and the Columbia Law School. He became a park commissioner of New York City under Mayor Low, and on Jan. 1, 1905, was appointed postmaster of New York City. He is President of the Grand River Irrigation & Development Company and of the Willcox Canal Co.

Mr. Wm. McCarroll was born in Belfast, Ireland, in 1851, and attended the Royal Academic Institute in that country. He came to New York City in 1869 and entered the employ of Alexander Studwell & Co., leather merchants. In 1902, when the American Leather Co. was organized, he became President. He is also President of the Manufacturer's Association and the New York Board of Trade and Transportation.

Mr. Edward M. Bassett was born in Brooklyn in 1863, graduated from Amherst College in 1884, and from Columbia Law School in 1886. He was a member of the New York City Board of Education from 1899 until 1902, when he was elected to Congress and served until 1905.

Mr. Milo R. Maltbie was born in Hinckley, Ill., in 1871. He was educated at Upper Iowa, Northwestern and Columbia Universities. He has made special study of companies operating under public franchises for the U. S. Bureau of Labor, Chicago Civic Federation, National Civic Federation and the Merchants' Association of New York City.

Mr. John E. Eustis graduated from Wesleyan University at Middletown, Conn., in 1874, and from Dwight Law School in 1877. In 1896 he was appointed Commissioner of the Board of Education, New York City, and served as Park Commissioner for the Bronx in 1902 and 1903.

Mr. Frank W. Stevens was born in Leon, N. Y., in 1847. He studied law at Harvard and is one of the foremost lawyers in western New York.

Mr. Chas. H. Keep was born in Lockport, N. Y., in 1861, and graduated from Harvard University in 1882 and from Harvard Law School in 1885. He practiced law in Buffalo until 1903, when he became Assistant Secretary of the Treasury of the United States. He is at present Superintendent of Banks of New York State.

Mr. Thos. M. Osborne was born in Auburn, N. Y., in 1859, and graduated from Harvard in 1884. He became President of D. M. Osborne & Co., manufacturers of agricultural implements, which concern is now a part of the International Harvester Co. He held the office of mayor of Auburn from 1902 to 1905.

Mr. James E. Sague, the only engineer on the commissions, was born in Poughkeepsie in 1862 and received the degree of M. E. from Stevens Institute in 1883. He spent ten years with the Chicago, Burlington & Quincy R. R., four with the Erie, two with the Jamaica Railroad in the West Indies, and ten years with the Schenectady Locomotive Works. He was for six years Chief Mechanical Engineer of the American Locomotive Works, becoming First Vice-President in charge of engineering and manufacturing. This place he resigned on March 1, 1907.

Mr. Martin S. Decker was born in Rosendale, N. Y., in 1858. He received a public school education and began his career as a telegrapher. At present he is Assistant Secretary of the Interstate Commerce Commission, at Washington, D. C., having held that position since the organization of the commission in 1887.

ENGINEERING SOCIETIES.

COMING MEETINGS.

AMERICAN SOCIETY OF CIVIL ENGINEERS.
Annual convention at the City of Mexico, Mexico, beginning July 8. Secy., Charles Warren Hunt, 220 West 57th St., New York City.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION.
July 17-19. Annual convention at New York City. Chairman National Committee, J. C. Hatzel, 571 Fifth Ave., New York City.

NATIONAL ASSOCIATION OF RAILWAY COMMISSIONERS.
July 29. Annual convention at Seattle, Wash. Secy., Edw. A. Moseley, Interstate Commerce Commission, Washington, D. C.

ILLUMINATING ENGINEERING SOCIETY.
July 30-31. First annual meeting at Boston. Secy., Dr. A. H. Elliott, 4 Irving Place, New York.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS.
Aug. 7-9. Annual meeting at Norfolk, Va. Secy., Frank P. Foster, Corning, N. Y.

TRAVELING ENGINEERS' ASSOCIATION.
Aug. 27-30. Annual convention at Chicago, Ill., Secy., W. O. Thompson, Oswego, N. Y.

ENGINEERS' AND CONSTRUCTORS' CLUB.—A new engineering society has been organized in Philadelphia, called the Engineers' and Constructors' Club, composed of engineers connected with the organization of Dodge & Day. Its object is to discuss subjects relating to engineering and construction and to give all members the benefit of the experience gained by each in his particular line of work. Four meetings have been held.

The proceedings of the club, giving the papers presented and the discussions, will be published regularly. The officers of the club are: President, Harold T. Moore; Secretary, George Walters; Managers, F. C. Andrews, H. F. Sanville, John E. Zimmermann, C. N. Lauer.

WESTERN SOCIETY OF ENGINEERS.—At a meeting held at the society's rooms in Chicago on June 26, Mr. Isham Randolph, M. Am. Soc. C. E., Chief Engineer of the Sanitary District, gave an interesting address on the water power plant, canal locks and other works under construction and contemplated south of the controlling works of the Drainage Canal at Lockport, Ill. He commenced his address by stating that soon after his appointment as Chief Engineer he recognized the opportunities for water power development, and during a vacation made a study of such development at Niagara Falls and elsewhere. He presented a report on the matter to the Drainage Board, and was censured by some of the members for wasting the Board's time and money on such useless work, although he explained that it had been done on his own time and at his own expense. He did not drop the subject, however, and the present power plant at Lockport (now nearly completed), as well as the contemplated plant further down, are proofs of the accuracy of his views.

The Lockport plant, described in Engineering News Jan. 18, 1906, comprises an extension of the original drainage canal, ending in a large basin across the lower end of which is the power-house, with turbines and electric generators for developing 50,000 HP. The power-house does not extend the full width of the basin, but there is a lock for canal boats, and also two bear-trap dams. Room is also provided for a ship lock in case the deep-waterway project should materialize. As a precaution against flood in the event of any failure of the works (as apprehended by the city of Joliet), a moveable dam is located at the head of the canal extension. When this is closed, the water in the original canal will be discharged through the present controlling works (bear-trap dam and Stoney sluice gates), which will ordinarily be out of service when the power plant is completed. This dam, 180 ft. long, resembles a huge steel lock gate, pivoted at the middle. It stands normally parallel with the stream, in the middle of the channel, with a concrete protection pier at each end. It is operated by electric machinery, assisted by sets of valves which cause the water pressure against one-half to overbalance that against the other half.

A PROPOSED SOCIETY OF CHEMICAL ENGINEERS.—A meeting of those chemists who were in favor of the establishment of a society of chemical engineers and who were in attendance at the American Society for Testing Materials was held at the Hotel Chalfonte, Atlantic City, Friday, June 21st, at 5 p. m. The meeting was called to order by Richard K. Meade. Dr. Charles F. McKenna was made chairman and Mr. William M. Booth, secretary.

Mr. Meade then stated that he, as editor of the "Chemical Engineer" had issued a call for the meeting because of the numerous requests which had been made that he should take the initiative in the organization of such a society. He further stated that he had been informed that a society of chemical engineers was in process of organization on the Pacific Coast, and he had been urged to make the movement a national one. Mr. Meade said he felt that such a society was really needed, and had sounded the profession by some fifty or more letters of inquiry to prominent technical chemists and engineers. A large number of those approached replied, expressing their opinions quite fully, and for the most part were in favor of the organization of such a society to be known as the American Society of Chemical Engineers. Those in favor of the organization thought it should have a high standard of admission, somewhat along the requirements of the American Society of Civil Engineers, and that it would prove of great benefit to all qualified technical chemists. It was suggested that such a society might, by the appointment of committees, solve many problems of engineering chemistry, widen the field of applied chemistry to the point where chemical plants will be designed as far as the chemical features go, by chemical engineers; further, the interests of the consulting chemist by the discouragement of unprofessional methods and if possible cause the elimination of all incompetent and dishonest followers. It might direct the education of technical chemists along lines most likely to be of benefit to the industries of the country, for the commingling of the ideas of professional men with those of teachers of applied chemistry and for the unification of the methods of technical analysis by committees which should represent both manufacturers and users. The encouragement of patent legislation which will give the greatest security to the inventor of chemical processes and appliances for carrying them out, etc., was a suggested field.

The discussion naturally turned first to what the term "chemical engineer" really means. This was answered provisionally by Mr. Booth as follows: "Chemists or mechanical engineers who design and construct plants of a nature requiring a thorough fundamental knowledge of applied chemistry may be termed 'Chemical Engineers'."

The various difficulties in the way of forming a society of chemical engineers were gone into at great length. Those who took part in the discussion being Professors H. B. Talbot, W. H. Walker and J. C. Olsen; Messrs. H. E. Diller, E. C. Holton, Andrew Robertson, A. D. Little and Richard K. Meade, and Dr. J. E. Stokes. Finally it was decided upon motion of Prof. Olsen to appoint a committee of five men with power to consider the advisability of organizing a society of Chemical Engineers; that this committee correspond with men likely to be interested, and further, that the conditions of membership of such a society be formulated. Dr. McKenna named the following: Prof. J. C. Olsen, Mr. A. D. Little, Mr. Richard K. Meade, Prof. Wm. H. Walker and Mr. William M. Booth. On motion of Mr. Olsen Dr. McKenna was made chairman, increasing the committee to six. It is expected that a report will be made sometime during the summer.